USING AFTER ACTION REPORTS TO EXTEND EXAMINATION LEARNING

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Abstract

Professors spend significant time preparing examinations designed to evaluate students' learning. Once the tests are administered, the professor begins a tedious and laborious process of closely scrutinizing each student's work, trying to determine if and where errors occurred in the solutions. Next, the graded exams are given back to the students with the encouragement for them to revisit each problem to see where they made mistakes. Guided by the professor's comments, motivated students will do the review and learn from their errors.

The concept of **After Action Reports (AAR)** was specifically designed to extend every student's learning beyond the exam. Each student is required to thoroughly analyze their own work to determine where they made specific errors. Students subsequently report their findings in an After Action Report submitted to the professor. The use of a report also helps students develop their writing skills since the professor reviews and comments on the After Action Reports prior to returning them to the students.

A pilot version of the After Action Report concept has been introduced in Engineering Statics, Engineering Economics and Highway Design classes. The students expressed an understanding and appreciation for the concept, endorsing the additional learning opportunity provided. This paper covers the details associated with the concept inception, development, implementation, and student responses of using After Action Reports as a method to extend the learning capabilities of an examination.

Introduction

Exams are usually the basis to evaluate how well students learned course material. The value of exams as a learning tool has always been questioned. Some courses use papers or projects as the basis for evaluation instead. These methods possess the advantage of directing the attention of students to their writing but have the disadvantage of providing the instructor with no opportunity to evaluate how well the students mastered the basic ideas and skills being taught.[(1)]

In lecture based courses it is even more difficult to replace exams with other means of evaluation especially when the course is problem solving in nature. Therefore exams are likely to continue to be utilized for evaluation but the challenge remains on how to make exams more effective as a learning tool. This paper suggests a step in this direction where students are given the opportunity to revisit their graded exams, review, and analyze and learn from their errors.

Concept Development and Implementation

Instructors written comments on exams are powerful communications that affect subsequent motivation and maximize students learning from exams. [(2)] Providing feedback to students is useful but usually marks the end of the learning process from exams. The concept of After Action Report (**AAR**) presented here has been developed to make the instructor's general comments on the exam extend the learning process for the students.

Instructors are encouraged to have students critique their exams and revise them based on feedback from students. [(2)] The **AAR** gives students an opportunity to provide this feedback while analyzing their errors. An example of this situation involves the majority of students commenting the exam was too long and they did not have enough time to work the last problem. This early feedback from students allows instructors to revise their exam styles if needed before the end of the semester when this student comment may appear on the course evaluations.

Introduction of the concept occurs on the first day of classes. Students are introduced to After Action Reports (**AAR**) during the discussion of the course syllabus, in general, and exams in particular. The intention of using the **AAR** as a learning tool and a way to improve writing skills is also discussed. Students are reminded that their skills in identifying and correcting errors will be utilized in the **AAR.** At UPJ many students have been introduced to the useful concept "Syntax Error Analysis" which involves giving the students a problem along with an erroneous solution. Students are asked to analyze the problem to determine where the errors occur in the analysis and make corrections. [(3)]

The specifics of the After Action Report (**AAR**) concept works as follows: Instead of making a detailed analysis of each problem to detect specific errors while grading an exam, the professor does a cursory review of the student's solution. This overview involves a quick look at any diagrams, basic equations, intermediate steps in the problem solving, and the final answer. Using this good template approach permits the professor to detect general areas where an internal error apparently occurred in the analysis. The professor draws a large circle around the suspect area and writes "internal error" in the circle. The professor then proceeds to deduct an appropriate number of points for that problem depending on the grading technique and style. When the exams are returned, the students are required to analyze every problem in which they had internal errors. Since specific errors were not pointed out, they must rework the problems in question and find out why errors occurred. This process involves a critical self-analysis of one's own work similar to what students will encounter in industry after graduation. After the entire examination has been scrutinized, the students are required to submit a brief but formal After Action Report to the professor. This report highlights the errors found and what the students learned when these specific errors were discovered.

The After Action Report (**AAR**) concept has been implemented in three courses so far at the University of Pittsburgh at Johnstown. The courses are Engineering Statics, Engineering Economics and Highway Design. The Engineering Statics is a sophomore level course taken by all engineering technology disciplines (Civil, Electrical, and Mechanical). The two Statics sections contained fifty five (55) students. The nature of the Statics course is primarily a lecture problem-solving course and it builds on previous knowledge of physics and math. The Highway Design is a junior level course. Only Civil Engineering Technology (CET) students take the Highway Design course and it is preceded by two-sophomore level courses in surveying. The Highway course is design and problem solving in nature. It develops students ability to use mathematical formulas, specifications and guidelines by design agencies, assumptions and finally common sense to recommend solutions for a given highway problem. The Highway Design class contained thirty (30) students. The Engineering Economics is a junior level course in which students come from all disciplines and the class contained twenty three students (23) with almost half of the class being seniors.

The Engineering Statics and Engineering Economics classes both incorporated the concept of "Student Learning Teams". The concept incorporates the major functional areas of teams (mission, roles, operating processes, interpersonal relationships, and inter-team relations) into "Student Learning Teams" for optimum performance. [(4)] The grading method in these two courses is based primarily on the student team's performance in which the performance of each individual is integrated with the team's performance to produce the final course grade. [(5)] Each team in these two courses prepared and submitted the **AAR** as a team effort.

Concept Evaluation

A questionnaire was administered at the end of the semester to obtain feedback from students on the concept and implementation of After Action Reports (**AAR**). A copy of the actual form can be found in Appendix A. The questionnaire consisted of three main sections: the first section included two general questions about the students' academic level (freshman, sophomore etc) and whether or not they normally do an extensive analysis of their examinations after they have been graded and handed back to them.

Figure 1 shows a summary of students' responses to this question. Surprisingly, Figure 1 shows majority of students do not normally do an extensive analysis of their examinations in other courses after they have been graded and handed back to them. Some variation in response is present between the three courses surveyed but on the average about three quarters of students expressed concept as a new experience for them.

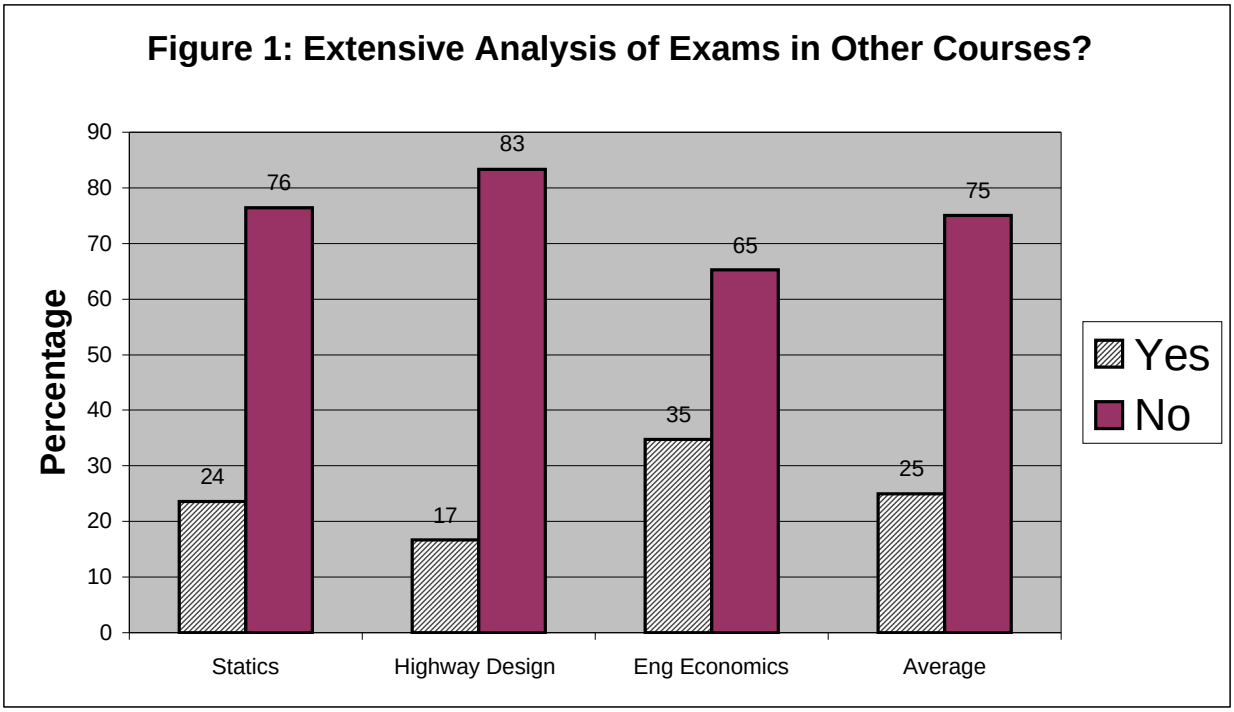


Table 1 summarizes the students' responses to questions in the second section of the questionnaire. The percent of maximum score has been used to quantify this response. The maximum score is the number when all students select "Definitely Yes" which has a value of five (5) as their response in favor of the idea (i.e. maximum score = 150 for a class of 30 students).

Table 1: Students Responses to Section Two (2) of the Questionnaire

No.	Question	Response as % of Maximum Score			
		Eng Statics	Highway Design	Engineering Economics	Average
2-a	AAR helped me/us learn the material better	60.0	76.0	63.5	66.5
2-b	AAR helped me/us identify any "problem solving" weakness	62.5	72.4	54.8	63.2
2-c	AAR helped me/us identify mistakes resulting from "human errors" or carelessness	76.7	80.7	78.3	78.6
2-d	AAR helped me/us identify mistakes resulting from a lack of understanding of the course material	64.0	70.0	51.8	61.9
2-f	Overall, I/we found the AAR helpful as a way to extend learning of the class beyond the examinations	61.1	74.0	53.9	63.0

The following comments can be made on the results of Table 1:

- Overall, the majority of students (score 66.5%) feel that the After Action Report (**AAR**) helped them learn the material better because they had to analyze "where" and why they made the error(s). Due to the academic level of students and the nature of the courses described above, students enrolled in the highway course appear to benefit from this activity more than other students in the other two courses.

- With average response of almost two-thirds, students indicated that the **AAR** helped them identify problem solving weaknesses. Again, the nature of the different courses surveyed and the level of students reflect some variation in their responses.

- A high percentage of students in all surveyed courses (about 80%) agreed that the **AAR** helped them identify mistakes resulting from "human errors" or carelessness.

- Nearly two-thirds of the responses indicated that the **AAR** helped students identify mistakes resulting from a lack of understanding of the course material. The responses to this question showed higher variation among the courses surveyed.

- A score of almost two-thirds indicated students found the After Action Reports helpful as a way to extend learning of the material beyond the examinations.

The results of the survey for part (2-e) of the questionnaire involved the students identifying where the errors were made as illustrated in Figure 2. One or more of possible errors could be checked. The following comments pertain to Figure 2:

- Regardless of their academic level and the course they are enrolled in, two-thirds of the students indicated Math errors are the predominant sources of their exam mistakes.

- Most students taking Engineering Statics did not feel that "not reading problem correctly" was the source of their errors and that is consistent with the nature of Statics exams where problems are relatively clear in terms of what is given and what is required and the limited ways to get to the right and perhaps only solution. On the other hand, problems on a highway design exam would include elaborate problem statements with missing information for students to assume or extract from appropriate resources. Design problems in some cases do not end up with a unique solution and the answer is not as important compared with the approach taken and assumptions made. Therefore, more chances exist to take the wrong approach when not reading the problem carefully and correctly.

- In a highway design exam, students are allowed to prepare and bring to the exam an equation sheet on which they can write any equation from the many they have in the text and class notes. There is a possibility that students may forget to record needed formula(e) on their equation sheets.

- In an Engineering Statics exam, a free body diagram is of most importance and an incorrect free body diagram is likely to lead to a serious problem in the solution. That may be why Statics students indicated "Incorrect diagrams" as another important source of exam errors. Most students in other courses did not indicate "Incorrect diagrams" as a source of exam errors.

- Less than a quarter of all students felt that their mistakes were a result of not having studied the material as they should have. In other words, most students believed that they do prepare themselves well for exams but other reasons may have contributed to their mistakes.

- Overall, almost half of all students felt that not allowing enough time to complete the problems has been the reason for their mistakes. This was especially the case in Engineering Statics while most students in Engineering Economics course did not think that "time" was a problem. Again, the nature of these exams and the different academic levels of students and their experiences reflect the variation in the responses.

- Few students indicated that there are other reasons for their exam mistakes including lack of concentration, not seeing some thing similar in class, and difficulty in reasoning of the True and False problems in Highway Design exams.

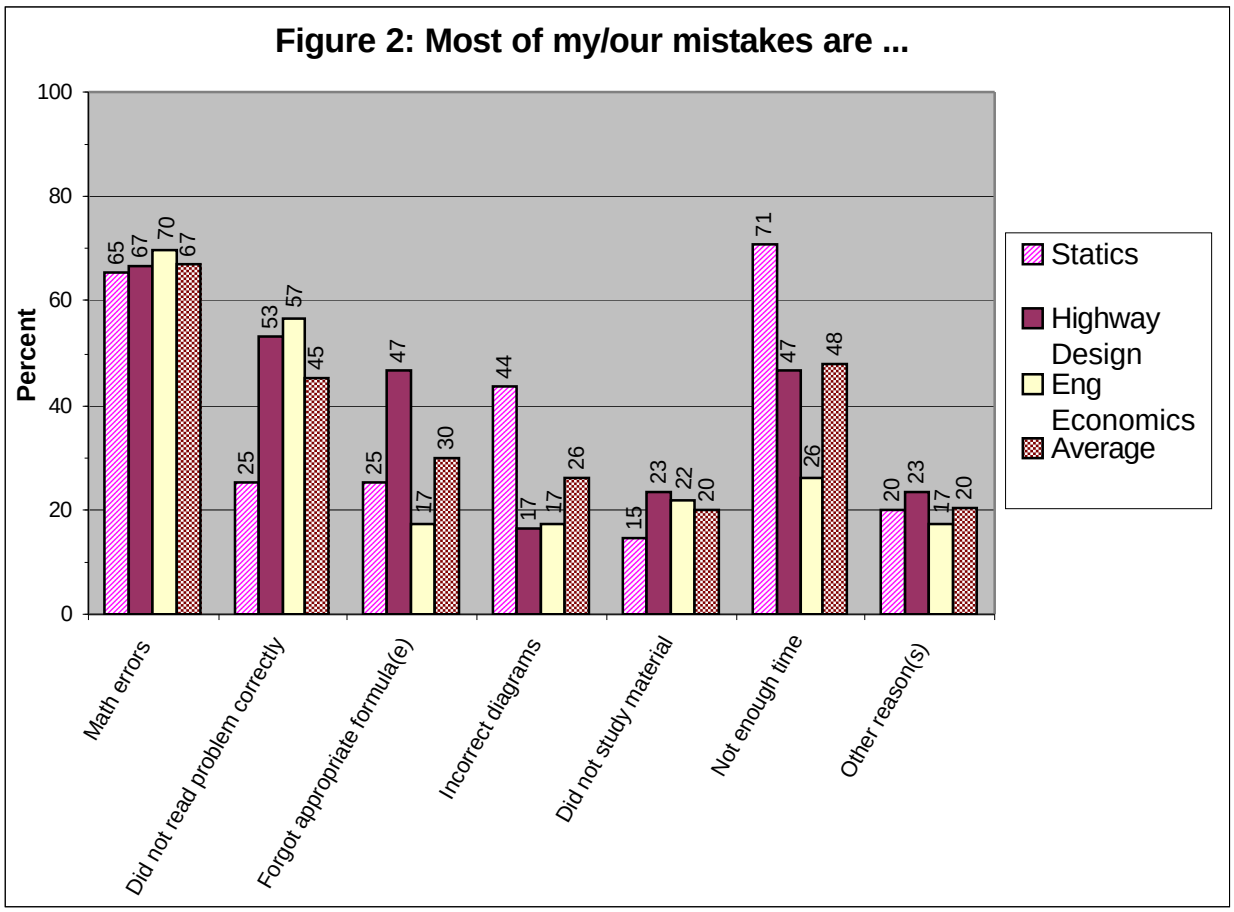
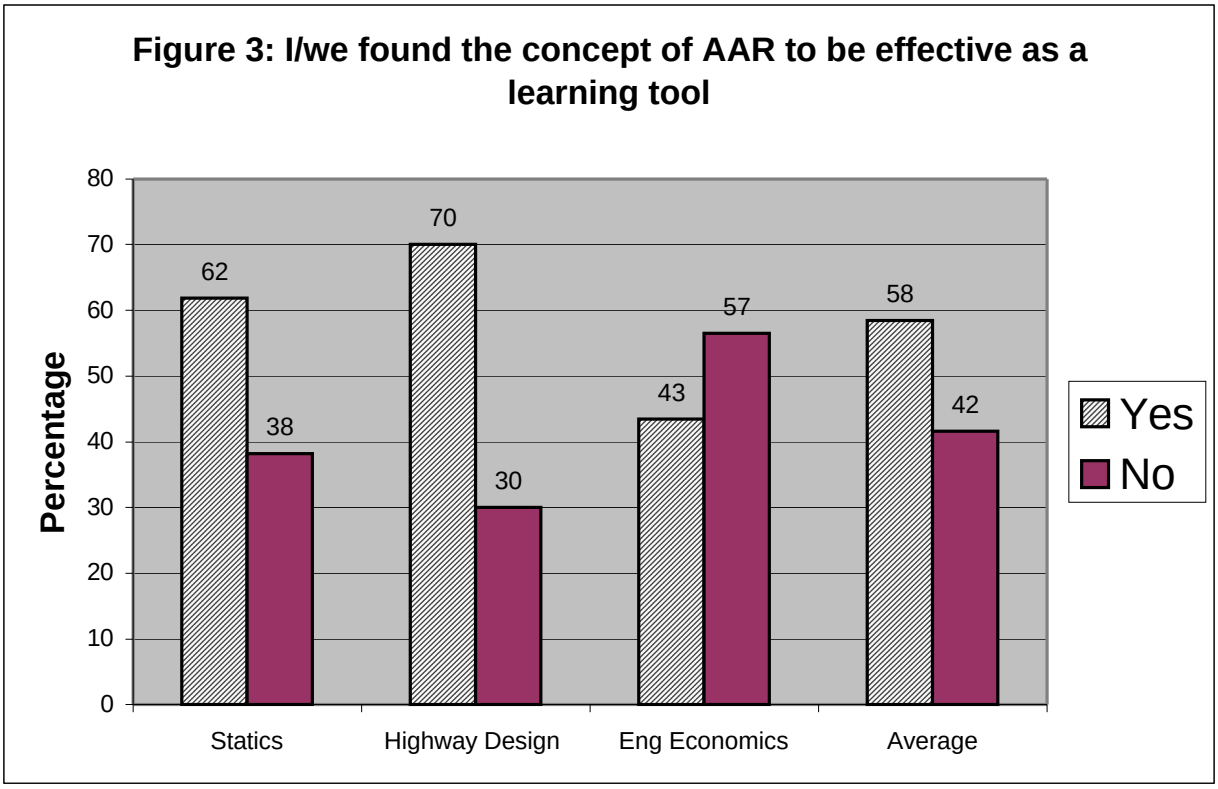


Figure 3 shows the results of section 3 of the survey which focused on the effectiveness of the **AAR** concept. The response to this was rather interesting. The question requested a Yes or No answer. In spite of the variation in responses among the three courses, almost 60% of all students did find this activity to be an effective learning tool.

It should be pointed out that some students also made written comments although they were not asked to do so by the questionnaire (see Appendix B). They were in general split between being in favor of the idea or against it.



Conclusions

Critiquing work in the engineering profession is the norm. Theoretically, no work should leave a firm until it has been checked as defined by a standard quality control process or procedure. Students look at exams in much the same way as we approach life. From a personal perspective we all make mistakes but few of us sit and rethink the events of a past day and how things could have been done better. It takes some courage to go back and review and criticize one's own activities. The After Action Reports give students the extra courage and incentive to go back and revisit and analyze their exam errors.

Most students appear to appreciate this educational and useful experience. Some do not find it necessarily pleasant because it reminds them of their mistakes. In addition, After Action Reports (**AAR**) require more work for students because they are required to review, search, analyze, and write a formal report. Sophomores tend to appreciate the concept more than seniors who admitted they did review their exams more frequently than when they first entered college.

Overall, the foregoing discussions gave evidence that the concept of After Action Reports (**AAR**) proved to be an effective learning tool that extends learning beyond the examinations. The author is planning to continue this activity in other courses and administer similar surveys in order to continue getting feedback from students. This will help in the improvement process of the **AAR** concept as a learning tool and its implementation.

References

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Appendix A: After Action Report Questionnaire

University of Pittsburgh at Johnstown – Engineering Technology

Please answer each of the questions below based on your individual/team experience with writing a "After Action Report" to analyze any errors made on your examinations.

Course Name: _____ Academic Level: _____Fr. _____So. _____Jr. _____Sr.

1. *In your other technical classes do you normally do an extensive analysis of your examinations after they have been graded and handed back to you? Circle your response.*

   YES NO

2. *Please circle the appropriate response to each of the questions below. The range of responses are from "**1**" meaning "**Definitely No**" to "**5**" meaning "**Definitely Yes**".*

a.	*The After Action Reports helped me/us learn the material better because I/we analyzed "**where**" and "**why**" I/we made the error(s).*	*1*	*2*	*3*	*4*	*5*
b.	*The After Action analysis helped me/us identify any "**problem solving**" weaknesses I/we have/had.*	*1*	*2*	*3*	*4*	*5*
c.	*The After Action analysis helped me/us to identify mistakes resulting from "human errors" or carelessness.*	*1*	*2*	*3*	*4*	*5*
d.	*The After Action analysis helped me/us to identify mistakes resulting from a lack of understanding of the course material.*	*1*	*2*	*3*	*4*	*5*

   e. *Most of my/our mistakes have been (Check one or more):*
   - *Math Errors* _____
   - *Did not read problem correctly* _____
   - *Forgot appropriate formula(e)* _____
   - *Incorrect diagrams (Freebody/Cashflow, etc)* _____
   - *Did not study material as I should have* _____
   - *Not enough time to complete problem* _____
   - *Other reason(s)* _____

f.	*Overall, I/we found the After Action Reports helpful as a way to extend learning of the class material beyond the examinations.*	*1*	*2*	*3*	*4*	*5*

3. *I/we found the concept of the After Action Report to be effective as a learning Tool. Circle your response.*

   YES NO

Appendix B: Students' Comments

"*The after action reports were a good idea because they made me read over and fix mistakes when I normally wouldn't*"

"*Good idea as far as an additional learning tool/process"*

"*I always hated looking at mistakes on my test because they are usually careless or syntax error, however, as much as I thought the report to be a pain, they give me a sense of reassuring me that I do know the material. I think every teacher should make students hand back a corrected test*"

"*A solution to the exam would also be helpful in understanding the mistakes made. Some times a mistake is hard to understand without the right answer*"

"*So far, it has not been necessary for me to write an After Action Report. However, as a general rule, I usually make an effort to understand mistakes I make on exams"*

"*I would have reviewed my work even without a report*"

"There were times where the report served no purpose. We recognized our stupid mistakes"

"*After Action Reports, should be used for all courses. They help to prepare for final exam*"

"*Although this was no help to me, I would have analyzed the problem anyway even if this was not required*"

"*After taking an exam it is a good practice to go back over exams and correct mistakes*"

"*It would work, but only if the student really looks at the After Action Report. I think some students simply did them because they had to"*

"*I think that students should get points for doing the report*"

"*The report made me look at something I already knew. I can see where this would help others though*"

"*This is something I do when ever I get a test back, formally writing it up did not add much to it"*

"*I feel that an After Action Report can be helpful*"

"*I think it was a good idea because it made you think about your mistakes*"