

## Student Journals as a Diagnostic Tool in Quantitative Engineering Classes

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### Abstract

Journaling is a common communication tool in English classes but not in engineering classes. However, journals can also be very productive for both students and instructors in classes emphasizing quantitative concepts. Typically, students submit journals weekly throughout the term and the content and format may vary according to what the professor needs to know. The professor reacts briefly to the journals with written comments either on a hard copy or by email. The purpose of a journal is to alert the professor as to how well a concept was understood or which students are struggling and perhaps give some prescriptive solutions. To assess the effectiveness of journaling, students at the University of Dayton were assigned weekly email journals in two introductory programming classes and an engineering economics class. The classes contain first to fourth year engineering technology students. The anticipated outcomes were to offer a quick check on the basic skill level of students, provide early intervention when a student did not understand concepts, create an informal communication with a professor so questions that might not get asked in class could be addressed informally, and finally, that writing skills would be practiced and improved. Based on anecdotal evidence gathered throughout the semester, this paper will promote journaling as a key success factor for students in engineering classes.

### Introduction

Many engineers keep daily or weekly journals as informal project records that ultimately result in more formal status reports. Sometimes the engineer's journal is just a personal record to help explain problems or to record agreements and lessons learned from the project. While journaling is widely used in the daily work environment, most journal writing in college is reserved for English and humanities classes. When engineering students write, it is generally in the form of a lab report. The authors' research yielded few results that documented the results of using journals in engineering classes. The premise of this paper is that journals should be more widely used in quantitative classes, including engineering, as a way to help students learn important concepts more thoroughly. According to ABET standards, "Technically trained individuals should not be considered educated regardless of the depth of their technical capability if they cannot communicate, both orally and in writing, their technical findings, thoughts, and philosophy to others around them."<sup>1</sup> Writing about learning in core classes provides practice for future engineers for communicating engineering concepts. The authors surmised that verbalizing the successes and frustrations of learning quantitative concepts or as Beall calls it learning the

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“language of inquiry”<sup>2</sup> would also help students reach a better understanding of the material. In theory, putting their struggles and successes into words, helps them understand the material better and may even lead to an occasional “Aha!” moment.

The authors of this paper decided to test whether assigning weekly journals in their classes in the Engineering Technology Department at the University of Dayton would be beneficial to student learning and, perhaps, to their own teaching methods. The journal assignments were used in two semester courses – an introductory computer class (3 sessions) that met once a week and an engineering economics class that met twice a week. Students ranged from new freshmen to graduating seniors. The computer class (SET153L), an introduction to Excel and VBA programming for Excel, was mainly made up of first year students. Engineering Economics (IET 317), an upper level class with mostly juniors and seniors, used financial and economic concepts to analyze cost related engineering decisions.

In this study the journal content was not expected to be voluminous but rather to the point and somewhat reflective. The students usually had a week to respond with their journals to allow time to complete homework or unfinished class assignments. Often students found that the material that seemed clear in class became less so when applying it to new problems. At this point the emails arrived with questions or even attached worksheets asking for more help.

### **Journal Assignment**

Part of each student’s final grade included points for the weekly emailed journals. Both instructors guided the content by requiring comments on the difficulty of the material, the student’s success with it, and specific questions about homework problems or in-class examples. Students were required to write professional emails (i.e., a clear subject line, good email practices, and a signature block). The instructors responded weekly by email with at least a sentence or two to each student. Some of the comments to the students were “boiler-plate,” but others were personalized to answer specific questions or comments. When a student expressed having difficulty, more emails were exchanged during the week so that the student and instructor helped solve the issue. Although some of the students had a very relaxed email style which included too many grammatical and sentence problems – especially among first year students - the instructors tried to encourage more formal writing practices.

### **Benefits of Student Journals**

The authors found that the journals did produce the results they had anticipated and were surprised at additional positive outcomes from the student journals. The benefits of the journal assignment and actual journal entries to support the claim are listed in this section. Student names, email subject line, greeting and closing were omitted to both save time and allow for anonymity; however, grammar and spelling errors were left in the samples to demonstrate a continuing need for writing practice.

*1. The instructor is alerted that several students did not grasp a concept from the previous lesson. Knowing the problems the students had before the next class helped the instructor plan a review or example as part of the next lesson. At other times, sending a group email with more information on the issue helped all the students find success with homework that might have*

remained undone, or done incorrectly. If only a few students had a problem, the instructor could write to the student directly with further explanation of the material in question.

This week in Tech Computation Lab, I found a lot of things difficult. I didn't quite get the understanding of Histograms and Filtering. The last assignment was long...For some reason, I don't understand the work when students teach it. That is why I don't understand filtering or histograms. But after asking (you) for help, I got the concept of Histograms...But other than that, I'm fine.

So far I get what is going on in class, except for the B/C ratio. For some reason I have a hard time determining what numbers go on top and what on bottom. So far I have been getting by though.

I am starting to understand how to use the cash flow diagrams that we have been covering in class. I am still a little shaky on the Arithmetic Gradients, I guess I am not exactly sure how you solved 3.30. When I was working the problems I did not get the same answer as you did on Thursday. I guess I am just confused about how you broke the problem up and did it in sections.

I would like to make one comment or suggestion, the emails that you send out with hints and answers make the problems easier to tackle since I have the answer to check with, cause when I get the wrong answer I can say hey no I'm not doing this correctly, and can go back and try something else, and that makes me think more and figure it out instead of just giving up and waiting until you go over it in class the next time.

2. *Emailing the journals allowed students who stayed up late to do assignments to contact an instructor who operated on a different schedule.* Both the student and the instructor could compose the email and send it without having to be available to talk directly. Students also could ask the question while it was fresh in their mind rather than try to remember it for a phone call at a more conventional time or for the next class.

I feel pretty comfortable with the new material, but am struggling with this weekend's homework. I listened in class but there are a lot of twists that I am not sure how to deal with in the problems. I know that it is 12:15AM as I write this, but I figured that you wouldn't mind that I remembered a couple minutes late.

Sorry this email is probably a few minutes late, I hope that's ok but I just remembered to do it as I was going to bed. Everything seems to be going ok for me in class. I seem to be understanding the material just fine, maybe a minor thing or two that I don't get but you usually clear things up in class. The project seems to be going ok, assuming I can get some numbers from work, which shouldn't be a problem. Well, that's about all I have. See you in class on Tues.

3. *Some students, especially in the computer class, had skills in an area that was being taught.* The instructor could then increase the pace of instruction rather than dwell on topics that were

familiar. Students will often not admit in class that something was covered in high school classes, but were willing to share that through a journal.

I thought this past week was pretty easy. I have programmed before in visual basic. I have never done macros in excel though, so this should be all new and pretty interesting to me. I took a visual basic programming course in high school that was very interesting. I liked the class a whole lot. I hope I can learn a lot on how to program in excel over the next couple of weeks. I hope you have a great weekend and I'll see you in class on Wednesday.

So far I have found the class interesting and did ok with the hwk. I do recall some of the simple/compound interest stuff from high school! I think it will just take a bit of time to get use to all the abbreviations and remember what they stand for.

4. *Students felt at ease "talking" with the instructor through email.* This familiarity continued in class and increased student participation in class. Although it was not measured formally, both authors agree that student participation was much better than when the classes had been taught without using journals.

The excel assignment last week was one of the more challenge projects to date. One of the trickier aspects was producing the right graph to represent the data. A couple of attempts to represent both sets of data on one graph slowed us down but we eventually got it right. After seeing how the values of the basket makers compared to production, it was fairly easy to make conclusions about where the money should be spent. I look forward to next weeks assignment.

I wasn't sure if a journal entry was due this week, but wanted to say a few words. I think the test went fairly well. I think I did better on this one than the first one so hopefully you will be generous with your grading - haha. There was one or two parts in the test that you will find "odd" but I feel pretty confident that I did better. Anyways, just wanted to say hi and I am getting ready to grab a beer. Talk to you later.

This week was also not too bad. I got stuck for a while on loops and how to get a range onto the spreadsheet, but I think I have it figured out. Also, I am forgetting concepts and codes from week to week. Good thing I have notes! When its challenging like last week, I think it sticks in my head a little better, since i have to dwell on it longer to understand it.

5. *Students who generally won't talk in class shared many thoughts, examples, and ideas in their journals.* This was one of the most surprising elements of the journal submissions and gave some insight for understanding the non-participant.

The journals were good in that i got response on stuff that i didn't understand, and i got the chance to speak up and say "hey i don't understand this or that" because i am not one

usually to speak up in class when i don't understand something in fear of looking dumb. I know there is no such thing as a "dumb question", but i am just saying that it is a lot easier to ask or state something in an email than it is to voice it in class. So, over all its a good feedback system, and we get the chance to ask or state things that we wouldn't otherwise in class.

I think that the journals are a good way to get feedback from the class. Even though they are easy to forget about, I think that if someone has a question, they might be more likely to ask it through the journal than in class.

*6. Non-traditional students who worked full or part-time and just attended a class or two each semester really liked the journals.* These students often worked homework problems at odd times and didn't have the schedule that allowed them to meet with the instructor during office hours. Communicating through emailed journals and having it actually count as part of the grade really benefited these students particularly.

So far in my tech computations lab, I have found that, at first I have had a lot of difficulties with some of the assignments. My only problem is to learn how to put things together. My other problem is that, I have been out of school for quite a while, so I tend to forget some things from my Database and computer science class, but when Ms. Reynolds goes over them, that's when I remember. And these courses are courses that I took in the 11th grade. The last assignment that she thought the class was pretty easy. The first one was a little difficult. I know I failed that quiz that we got on Wednesday, September 4, 2002. My problem is that I know the material, but I just don't know how to put them in words. Or my definition might be different from some else definition which confuses me a lot. As towards the computer, their nice. They move fast and they look brand new. I haven't had any problems with the software yet. Overall, I think that this class is going to exciting because I like to learn about programs.

This week we began covering interest and its relationship with past and future principals. We also went over the steps in the decision making process. The homework problems were fairly simple and the concepts discussed in class were easy to grasp. My only frustration comes from the fact that I have not been in school for over two years and the adjustment has been somewhat difficult. Next week we conclude chapter one and move on. I am looking forward to it and I hope this message finds you well.

*7. Some students also wrote some very positive statements that they wouldn't normally say aloud in a classroom.* The instructors were most happy with this unexpected benefit.

Programming is really clicking with me. I am pleasantly surprised, because I have never programed anything before. I figured I would be behind the rest of the class, but in my small groups I am usually the one answering questions instead of asking! Thanks.

Journals-I liked these as well. I have no problem asking questions in class but if I did this would be perfect. Also as I've learned from you thus far, this is a great way to measure if people can perform a simple task-on time-and correctly. Take me for example, almost every journal I sent was late. This made me realize even more what I already knew about how bad I am with being on time. What it does is force me to be accountable to myself as well as you. I believe you should continue using it.

8. *Students who had to miss a class were able to get caught up and also to give the instructor their reason for the absence.* Many times, the instructor was notified ahead of time when a job interview or other excused absence was coming up and the homework and handouts were sent right away.

Week 8 didn't give me that much problem. I understood the work real good. The if statements had me a little puzzle at first because I didn't know the propose of the if statements. But a little bit of practice and I will perfect it. A next thing about week 8 is that I didn't get a chance to get the take home quiz, so that might cause a problem for my week 9 grade.

Well, I'm officially behind. I have not made ample time to reveiw the material/read the chapters for class and I have not completed homework assignments for the past two chapters. I began work on the ch. 7 assignment for Tues. since I have attended class, I feel confident with this assignment but it requires looking back into previous chapters to verify some assumptions. I will catch up on my readings this week and be sure that I am prepared for class. I apologize that I am unable to offer you any input for class this week.

Everything is going good in class, and i think I am almost ready for the test. I have to do the homework due Tuesday and then I will be up to date. Sorry for not turning in the last hw assignment, but i had two tests that day and i did not get it finished in time. However i did do it the next day, and understood it. At least I think I understood it. See you in class on Tuesday.

9. *Students became more comfortable with the university computers and software.*

I sent this to you last week. This is the second time that you haven't received something from me that I sent so I will now use your other email address. I hope everything is cleared up now. I know the importance of promptness. I will see you Tuesday

Here is the first weekly journal that apparently didn't get to you. As you can see in the header from the original message, I had the email address wrong. This should be all set to go now. Thanks again for your help. Today's class also helped to clear up a few other things.

10. *The instructor and student can exchange the logic of a class problem using the journal.* Sending the code or formulas back and forth allowed the instructor plenty of time to examine the

problem. Often complex problems can't be solved in two minutes, and the professor will do a better job in a quieter, less hectic environment than the classroom.

Here is the code for the C and D columns.

```
For x = crangenum To 1 Step -1
    backnumrange.Cells(x).Value = x
    backcolorrange.Cells(x).Interior.ColorIndex = backnumrange.Cells(x).Value
    If (backnumrange.Cells(x).Font.ColorIndex = 2) Then
        backnumrange.Cells(x).Font.ColorIndex = 30
    Else
        backnumrange.Cells(x).Font.ColorIndex =
backcolorrange.Cells(x).Interior.ColorIndex
    End If
Next x
```

And I just saw what the problem is.

It should be `If(backcolorrange.Cells(x).Interior.ColorIndex = 2) Then`

Odd I couldn't catch it in the editor, guess I just needed to look it at differently.

As far as the homework goes, I haven't been able to get problem 3.30 to come out with the right answer yet. I have been using the NPV formula, which seems to make sense to use, but I may be using it wrong. Let me know if you have any other suggestions. Excel file attached.

I keep trying to do the incremental rate of return from the 10 cu.ft. to the 8 cu.ft and I keep getting an IRR of 48.10%. I'm not sure what I'm doing wrong, I've double checked my numbers, maybe you know of something off hand that could be causing it? Excel file attached.

### **Concerns with Journals**

No communication tool is perfect, and the authors have a few reservations with using journals. After looking at these issues, presented below, anyone using journals will have a clear understanding of both the benefits and drawbacks of using student journals in quantitative classes.

#### *1. Reading and responding to journals takes time.*

Thanks for the journal for week 10. Your problem with color is a strange one so I'd have to look at the code to find the problem. Be sure the if statements are inside the loop and not after or before the loop. Just send the code in the body of the email and I can give you a few hints. You really seem to understand what we are doing and should have no trouble from here on.

#### *2. Keeping track of who did journals each week is also an added time element.*

3. *Sometimes good students had little to say and each journal sounded like the last one. This student was an “A” student from the beginning of the class until the end and each journal politely responded:*

This week was alright. After I figured out how to do what I was supposed to do it was easy. Programming is pretty fun. I like this part of the class so far. Hopefully it stays this interesting. Have a good weekend. I'll see you in class on Wednesday.

4. *For some students having the quick feedback served as a crutch for them to avoid thinking but instead they used it to ask for help without putting in effort to understand. It may take a few weeks to figure out who is trying to let the instructor solve the problems rather than spending personal time on a problem. Sending back more questions to find out what the student has done on his own is probably the best way to push the student to keep trying. Students who do not have a firm base in pre-requisites presented the biggest problems.*

I was working on the homework today (the 3 problems you assigned) and i realized that I don't know what I thought I did what we did in class. The first problem I think I have the cash flow right but its hard for me to pick out which formula to use. The second one is confusing me because of the 3 different percentages. Everything else is going great though, I'll ask ya again in class.

5. *Encouraging good grammar and formats was difficult especially for the first year students. This example is from a first year student on the last week of the semester:*

What we are doing now is not that difficult no mater is ew for me. The only thing is that sometimes i didn't knew when to put the question for the command of the loop or whatever so it appear how it was supposed to be o the sheet paper with the corest calculations, but once i get it I figured out it is not that difficult. There is a problem and is that I did not save the first individual assignment so i can not do the second part. If there is a way that you can send me that first individual assignment it will be prefect so i can send it to you tomorrow. If not I guess it will have to be on class or for any day this week. PLease let me know what can you do. I'm sorry ofr that, but thank you.

And a senior wrote:

I became a little more inclined on what is going on but i still somewhat confused on what to do. but i think the more problems i do the more i try to see what i am really doing. i haven't started the excel yet, but i will let you know how it goes.

6. *Students seemed to like the journals which may present problems for other faculty who do not use them.*

I do appreciate all the emails you send to the class regarding homework assignments and general news. You are the only person to do that and I believe it is a big help. Have a great Thanksgiving.

7. *Students need readily available computer access and reliable, easy to use email software to*



*do the journals successfully.* At UD, all students are on the same email system and have a campus-wide email address book.

8. *Not all students (e.g. non-traditional or part-time) use the university email and miss some of the general responses.*

### **Lessons Learned**

After a semester of journaling, there is no doubt that the authors will continue to use journals as a way of communicating with students in quantitative classes. The following section outlines the lessons learned by the authors in the course of a semester of journaling.

1. *When replying to students, have a greeting, first line, and signature block that can be copied for each student.* All you have to do is add to that to respond individually to each student's journal. This saved lots of time.

2. *Email cannot be the only communication method. Sometimes, the student needs face-to-face time or a telephone call to deal with a problem or concept.*

I tried that house problem again. I can't figure out how to find the value after 6 months. I know i know how to do this, but i am just blank. Please take a look at this for me, and either email me back trying to explain it, or maybe i could stop by after class on tuesday night, and you could explain what i am missing on this. Thanks for the help.

3. *When questions came up on the same point from more than one person, a general email to the class was sent to help all the students understand the issue before they reached it in a homework assignment.* The university has email addresses that make sending group messages easy.

4. *Journals should not be mandatory every week.* In this study the computer classes did not write journals the last three weeks, and in the engineering economics class students could miss any three. In the future, we would probably make them mandatory for the first half of the semester and then require only occasional input after that.

### **Conclusions**

Although the positive effects of journaling on student understanding and retention of quantitative material needs more study and a much more rigorous statistical analysis, the authors are convinced that journaling students did perform better, had a more positive attitude about course material, and willingly worked in a more collaborative mode with the instructor to understand the class material.

In the engineering economics class those students who regularly used the journal, even if they only occasionally asked a question, ended up with better grades. Of the 15 students with the lowest class grades (i.e. 84.3%, 77.3%, etc.), only 3 completed all the journal entries. Of the top 14 students, only 2 didn't complete all the journals. This might not be entirely surprising or relevant to the value of journals since they did receive a few points (18 out of a total of 398 for

the class) for each entry and that alone may have biased the performance results.

In the computer course, two of the three classes were required to complete journals. The control group consisted of just 10 students so it's not appropriate to attempt a defensible cause and effect relationship. However, from in-class observations during the semester and class grades, it's clear to the authors that the journaling classes did better than the control group.

And finally, we are now firmly convinced that every class can and should include some assignments for writing competency. Our student's writing skills were surprisingly worse than we expected and may be the most critical factor in their overall academic performance. Responding to poor grammar and spelling can increase a student's awareness of the problem and result in better email content. Both authors found that student writing had improved by the end of the semester.

Students who write about what they are learning in computational classes expand their understanding of class content when they have to turn cognitive thoughts into words.<sup>4</sup> Although there are some time issues involved in using weekly journals with students in quantitative classes, the benefits were impressive enough to ensure that journals will continue to be used in the two classes in this study and other classes that the authors teach. Of course the real beneficiaries are the students in these classes who are learning skills that they will transfer to the job. Better understanding of their academic material and improved writing skills will lead to more confident and competent career engineers.

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