

Project Failure 'not an option' with Active, Team-Based Learning

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Abstract

The ten project management body of knowledge areas are an important project management framework that students should know, but it is difficult to get students to even recall and list the areas when asked. This paper explores the development of an active learning and team-based learning exercise introduce this important topic. The popular classic film *Apollo 13* was used to engage students in learning about the project management knowledge areas. Working in teams and after viewing a memorable scene, students were asked to identify an issue in each knowledge area. Results indicate that students are engaged, their basic recall of the PMBoK areas improves, and that the active learning strategy was superior to lecture-only. The complete assignment is fully described so as to be adopted by the reader.

Keywords: project management, team-based learning, active learning, learner-centered

1. INTRODUCTION

An important aspect of any information systems (IS) project management course is coverage of the primary project management (PM) knowledge areas, of which there are ten. This knowledge areas are important for several reasons, and student mastery of them is an educational priority. The material, however, can come across as dry, list memorizing. This paper explores this instructor's efforts at conveying their importance in an engaging manner and to produce student mastery.

The purpose of this paper is to describe the active, team-based learning exercise developed to engage students in learning the project management body of knowledge (PMBoK, pronounced "PEM-bok") areas (Westland, 2019), and to evaluate its effectiveness in my course.

Along the way, a traditional lecture approach is compared to an active learning strategy. At first, I used a lecture-only strategy to convey the importance of the PMBoK areas. Later, I supplemented lecture with an active learning strategy. Mastery of the PMBoK areas was demonstrated in basic recall of the ten areas as

well as in higher levels of learning. The remaining sections of the paper discuss the background of the problem, the development of the assignment, the results, and conclusion.

2. BACKGROUND

PMBoK Areas

The ten project management knowledge areas are taught in the co-author's project management course. The course is offered as an upper division (3rd or 4th year) requirement of four-year college degree programs in IS, information technology (IT) and health informatics (HI). One of the learning outcomes, published in the course syllabus, revolves around the ten knowledge areas, and is formally stated as "apply project management principles and techniques for managing in multiple PMBOK areas that include project integration, scope, schedule, cost, quality, resource, communication, risk, procurement and stakeholder management."

The PMBoK areas, established by the well-known Project Management Institute (PMI), are important. They are the underlying framework of the PMBoK, and all PM textbooks use these areas

as their organizing framework, too. All project management knowledge is encapsulated within these areas.

They are introduced early in the project management course, in the very first set of topics, in fact. Despite being given lecture emphasizing their importance, few students were able to recall more than five of them on a quiz or the midterm exam. Their importance lies not only in basic recall—an alumnus once told me that he would ask student and alumni applicants to rattle them off in job interviews—but in seeing how there are relationships among the various areas when it comes to project management problem-solving.

From Lecture to Active Learning

Three years ago, I changed the way I introduced the PMBoK areas in that early class meeting. I redesigned the approach away from lecture to a more active and team-based approach. The trend in higher education since before the turn of the century has been towards more active, learner-centered, and even team-based approaches to learning (Bonwell & Eison, 1991). In information systems education, a paradigm shift from teaching to learning has been building since at least the aughts (2000s) decade (Saulnier, Landry, Longenecker, & Wagner, 2008). Active learning, in general, is defined as any teaching method that engages the students in the classroom where they are doing something besides just listening (Prince, 2004). Whereas lecture is considered a passive active, doing something else, quite simply, is more active. An ISCAP journals search on Sept 28, 2022, for the keyword "active learning" resulted in 73 hits. The articles spanned the years 1995 to 2022. I reviewed those articles dealing with active learning in projects and project management. The results show that active learning has been used in project coursework with success.

A traditional approach to active learning has been the use of student-developed projects. Hoxmeier & Lenk (2003) and Reinicke & Janicki (2010) reported on the deep learning gains from community-related service learning projects and capstone projects, respectively, while Wong (2017) made use of entrepreneurial-inspired projects in the systems analysis and design course.

Active learning has been used in the project management course as well. McAvoy & Sammon's (2005) adoption assessment matrix, completed in a workshop exercise, showed students the advantages of the agile methodology. Schmitz's (2018) Scrummy agile role-play assignment was

found to be more effective than reading and lecture. Sibona, Pourreza, & Hill (2018) found student perception of agile learning to be greater when active learning (origami exercise) was added to lecture.

Team-based Learning Pedagogy

Team-based learning (TBL) is a comprehensive active learning approach for a course (Michaelsen, Knight, & Fink, 2004). It utilizes backward design (defining and designing around exit outcomes first); permanent, balanced teams; peer evaluation; readiness assurance tests (RATs—individual followed by team quizzes); and application activities (team and individual exercises that build on the RATs) in several iterations throughout a course.

The resulting exercise that I designed was the Failure Is Not An Option exercise, featuring the analysis of a scene in the classic film, *Apollo 13* (Howard, 1995). I designed it as a TBL team application activity; required students to actively watch and analyze a scene from the movie; and asked them to analyze issues in all ten PMBoK areas. This exercise is described in the next section.

3. ASSIGNMENT DESIGN

More than 53 years since man first walked on the moon, the space program is still inspiring. Despite not reaching the moon, the Apollo 13 mission has been dubbed "NASA's finest hour" (Evans, 2020; Granath, 2017). The astronauts in space and the crew on the ground worked feverishly to get the astronauts home safely after a mid-mission explosion on board the spacecraft. The film further popularized the mission. The inspiration of Apollo 13 and the space program can make students realize that project management has been part of some of humankind's most notable achievements.

Director Ron Howard's popular 1995 film won two Oscars and numerous other accolades. The screenplay was adapted from astronaut Jim Lovell's book (Lovell & Kluger, 1994), and starred Tom Hanks as Lovell. Movie scenes in general make for engaging material if they can be related well to course material. I have found that the typical college student will be familiar with films only in the recent past. Mostly, today's students can be counted on to have seen on the Marvel comics films. However, they are also familiar with classics such as Star Wars and other films. In the case of Apollo 13, most will not have seen it. I have found it is crucial to include the set up narrative to help explain the issue of the mission.

As this is the first assignment of the semester, it is also the first assignment following the formation of teams. As it is so engaging, it helps to get teams kick-started well.

Assignment Purpose

As the assignment uses the concept of the transparent assignment, I made three parts of the assignment apparent to students: purpose, tasks, and criteria. There were three learning outcomes defined for the assignment's purpose. These are posted for the student to read in the assignment's Purpose section:

- Complete a collaborative activity within and across teams that requires accountability, trust, and cooperation
- List and differentiate among the ten project management knowledge areas
- Analyze a project situation for problem-solving issues within and across PMBoK areas

The first objective is important for team formation. As part of the first team activity, they are to elect a team leader and come up with a team nickname. The second outcome has to do with knowing the ten areas and differentiating among them. It is a lower level outcome that is nevertheless important. I would ask them to list these areas from memory on the midterm exam. The third outcome is at a deeper learning level.

Preparation

The assignment write-up continues with a To Prepare section with three steps:

1. You should have viewed my video on the ten project management knowledge areas. (A link to video is provided.)
2. Please view this movie clip before we meet. It is a clip from the movie Apollo 13 (1995), starring Tom Hanks and directed by Ron Howard. Known for being historically accurate, the film is a true story of the space mission that never made it to the moon as planned, but was still a heroic success. En route to the moon, the spaceship suffered an explosion. The astronauts were running out of air, and may not have had enough power to get the ship back home safely. In this scene, entitled Failure Is Not An Option, the flight team in Houston is in hot debate over how to save the mission. (A link to video is provided.)
3. In class, we will break into groups and work on the problem. You are to identify the key Apollo 13 project issue in as many areas as you can or that your instructor

asks. The areas are scope, budget, schedule, quality, communication, risk, resources, procurement, integration, and stakeholders. Turn in as an attachment in Canvas to complete this activity. Be prepared to share with the rest of the class at the end.

The video obtained from the Internet was edited by a graduate assistant, removing a profanity (that would violate the second commandment—Catholic version). It runs for just over two minutes (2:01). It features a lively debate among flight engineers as to how much power is left in the spacecraft's batteries. The decision is turn all equipment off and work on how to save enough power to get them back. It ends with the emotional plea of Flight Director Gene Kranz, portrayed by actor Ed Harris: "We've never lost an American in space, and we're sure as hell not going to do it on my watch. Failure is not an option."

Tasks

The assignment tasks listed for the student teams include these:

1. Think about the video clip that you saw from the Apollo 13 film—"Failure is not an option". For as many of the ten PMBoK areas as possible, discuss with your team an issue from the Apollo 13 project, based on our viewing of the Failure is Not an Option movie clip that encompasses that PMBoK area. List your issues below, identified as PMBoK area – Issue, and be prepared to have your spokesperson discuss.
2. Complete in the Google Sheet (links to an external site) during class, using the tabbed sheet with your team's number on it.
3. Select a team nickname and a team leader, and write these at the bottom of the Google Sheet for your team.
4. Be prepared to have a member of the team discuss the team's solutions.

The teams are graded based on the following criteria:

1. Number of areas addressed is at least 5-6 (7 of 10 points), 8-9 (8 or 9 of 10), all 10 (10/10)
2. Issue addressed should make sense for that area, and is specifically dealing with an issue related to the project.

In-Class Execution

At the beginning of class, I start by repeating my (video) explanation of the ten areas, ever so briefly. For example, I will say, "scope is all the work. Schedule is the time it takes to complete the work...", etc. See Table 3 in the appendix for a description of the ten areas and my quote for all of them.

As I explain them, I add de-mystifying remarks: "These areas make sense and are not hard to grasp. We will get a whole chapter on each area, but I can tell you just a little bit about each one, and that will be enough for us to understand them and do something with them." The students do not need to do a lot of deep reading to be effective on this assignment.

I then turn it over to the team of students sitting together. They will deliberate for task 1, and record their answers in a Google sheet for task 2. The Google sheet requires sharing with them. They must click on the numbered tab for their team, entering their answers on that sheet. They are asked not to peek at any other teams' answers.

I walk around the room checking on the teams. The common questions are "what is an issue?" (answer: it can be how that area, such as scope, is defined, or something else, such as what is challenging about something in that area, or how that area is interrelated with something in another area.); "how specific or general is our issue to be?" (Answer: you can write it up concisely, but your spokesperson should be able to explain it.); "what is integration management again?" (Answer: this is the trickiest one—it is how one area relates to other areas.); "what is procurement? (Answer: outsourcing, dealing with contractors, outside of your NASA, suppliers.)

TBL team application activities are designed around the three S's. The first S is for specific choice (rather than long, complex) deliverable. In this case, ten brief issue statements were required. The second S is for same problem. Each team works on the same problem rather than different problems. With all teams working on the same problem, the comparison that takes place during discussion is more meaningful for learning, as all teams would be familiar with the problems of the other teams. The third S is for simultaneous report. TBL activities require all teams to finish independently, so that there is no answer drift, such as "I agree with them." Each team had to turn in their assignment in the Google sheet, and unless they copied or else

edited during discussion, they cannot deny what they put down.

Once they have completed all four tasks, which takes 20-30 minutes, we open it up for class discussion, and I call on each of the team leaders (or their designated speakers), while displaying that team's Google sheet on the screen.

I start by acknowledging the team leader and asking for the origin of the team nickname. I ask questions about some of the issues they identified, and compare across teams. By the end, I try to sum it up and provide takeaways. This semester, I gave them a 17-item anonymous student engagement survey.

See Table 3 in the appendix for a summary of assignment implementation, including examples of what students define as issues in each area.

4. RESULTS

In this section, I evaluate the results of using the Apollo 13: Failure is not an option exercise. I examine the attainment of the three learning outcomes, make a comparison of lecture-based to active/TBL approaches to PMBoK area coverage, and provide data on student engagement.

Outcome Attainment

The first of three learning outcomes for the assignment was to collaborate on a team activity, and begin to establish accountability, trust, and cooperation. Over the course of several semesters of using this assignment, nearly all teams cooperate and complete the task. Student perception scores given in the next sub-section below provide evidence that teams value the group work.

The second learning objective was about their ability to list and differentiate among the areas. Teams nearly always are able to identify a meaningful issue in all ten areas before running out of time, and they tend to get them right. The areas tend to fit and be important. Sometimes they put something similar for risk and quality, because they are kind of the same. Typical responses for all ten areas are provided in Table 3 in the appendix.

The third objective was the higher level outcome about problem-solving issues within and between PMBoK areas. This one is at the application or analysis levels. Sometimes, students have interesting insights. For example, we may get a discussion that involves constraints. "The limited time to solve the problem prevents a more

detailed analysis of the problem, and thereby is a key component of risk and a constraint on quality.” One of the insights this year was from a team that, for quality, put “being attentive to the task at hand.” By this, they explained that the engineers really had to understand the specifics of power consumption, and be persuasive about a course of action in the team meeting, in order for the goal of returning the astronauts safely to be possible. They were observant to the details of the scenario in the clip, and tried to relate it to a knowledge area.

It is important to note that these outcomes would be achieved by teams, not individuals. However, according to the stated goals of TBL, the intent of the collaborative activity would be to contribute to individual student learning.

Lecture vs. Active Learning Comparison

One test of individual student learning is in basic recall of the ten PMBoK areas. I had available data in cases where students, prior to this assignment, were asked to recite the ten PMBoK areas on the midterm exam. Back then, I only lectured on the PMBoK areas and their importance. During this time, I tested 63 students over three semesters (Sp18, Fa18, and Sp19). They recalled an average of 5.8 of the ten areas on the midterm question. Since implementing the Apollo 13 team activity, students now average 8.5 (n=120) over four semesters (Sp19, Fa19, Fa21, Sp22) on the basic recall question. Note: during the pandemic, the basic recall question was omitted from online midterm exams.

The results in Table 1 below include aggregate scores on the midterm PMBoK question and the whole midterm score itself. The three lecture-only cohorts and the four lecture + active learning cohorts were both lumped together and compared.

PMBoK Pedagogy	N	Midterm PMBoK Mean	Midterm Mean
Lecture only	63	5.8	75.3
Lecture + Active	120	8.4	77.4

Table 1 - Lecture vs. Lecture + Active Learning for PMBoK

The difference in mean scores on the PMBoK question was significant (t-test) at a p-value of 0.00000087. The overall midterm means are given to provide a rough indication that student performance did not radically improve between the lecture-only and lecture+active learning eras. The 2.1-point improvement in the mean score is

in fact very close to the 2.6-point improvement on the PMBoK score. The format and content of the midterm exam were stable, although section weights varied during both eras from semester to semester. There were four sections as follows, with low and high weights: matching vocabulary (10-20%), multiple choice (20-30%), short answer (20-30%) and problems (22-50%).

Student Engagement

To evaluate student perceptions of the activity’s effectiveness, I used a student engagement survey (Wiggins et al, 2017) on the most recent cohort of students participating in the learning activity. A sample of 21 students from two fall 2022 sections (n1=16, n2=5) were surveyed. Two students in the first section either were absent or did not participate for a response rate overall of 21 of 23 students or 91.3%.

Section	N	Value of group work	Personal effort	Instructor contribution
1	16	5.75	5.94	6.09
2	5	6.38	5.87	6.25
Both	21	5.90	5.94	6.13

Table 2 – Student Engagement, Fall 2022

Three constructs were assessed: value of group work (9 items), personal effort (3 items), and instructor contribution (4 items). The results indicated that the means of all three factors were above the scale midpoints (4 on a 1 to 7 scale). Section 1 (n=16) was taught by me, while Section 2 (n=5) was taught by a different instructor. Although the sample is small, it is the first test of the activity using two different instructors. The results are similar. See Table 2.

The results indicate that the students recognized instructor contribution a bit more than either the value of group work or personal effort in both sections. All values were above the level of “Somewhat agree” while the section 2 value of group work and both sections’ instructor contribution were above “Agree.”

5. LIMITATIONS

There are several limitations to these findings. Most of the time, the instructor was the same instructor, and only recently has this exercise been used and evaluated by another, and that was for a very small section. The comparison of lecture only to lecture + active provided evidence of the superiority of the active learning design. However, it does not hold up as a scientific experiment due to non-random samples, unequal

sample sizes, and other confounding variables (such as historical comparison, then vs now). Support for team success on outcomes 2 and 3 was anecdotal at best. Student perception data was only available for one semester—the most recent one. Subsequent individual student success was assessed only on a low-level outcome—basic recall of PMBoK areas. To the extent that the exercise was effective, there was not definitive evidence as to which of the assignment's features contributed most.

A further limitation results from the conceptualization of the study. Because I am comparing a sort-of straw man—lecture—to active learning, this study may not contribute as much as if I had compared my active learning activity to something else, such as a written case study essay. This could be a fruitful future direction.

6. CONCLUSION

In summary, this paper described an active, team-based learning activity in a fundamental project management topic—PMBoK areas—so that the readers can implement it themselves. Assignment details were provided.

The brief overview and de-mystifying statement was intended to make students confident that they could master the content easily. The movie provided a dramatic context. The space program was and still is a universally appealing project management area. Students had the opportunity to learn actively and with peer collaboration. Students appeared to be engaged, and quantitative evidence showed they were. Student teams consistently and effectively applied the concepts to the case. The feedback provided needed guidance and re-affirmed to them that they were learning. Higher midterm results for individual student recall followed as compared to a lecture-only approach.

It is not possible to assess which components were more or less effective than others in producing the results. What we do have evidence for are perceptions of instructor contribution, value of group work, and personal effort across two sections in the most recent semester. All of this means that there is evidence that students were engaged. It is advisable, therefore, to keep all the components in the assignment.

The activity was successful in that teams were successful across both low-level and high-level outcomes. Furthermore, there is evidence that individual students in the active learning situation

demonstrated better recall (low-level outcome) of the ten PMBoK areas versus students in the lecture-only format.

Tips for Implementation

In a project management class, the following are recommended. Ideally, this assignment should be given in the first or second week. Use your permanent teams or set up ad hoc ones. Follow the guidance in this paper exactly. Contact the author for a copy of the assignment, the two videos, and the Google sheet used.

It may be desirable to follow up the activity throughout the semester. One way I do this is that, when I introduce a topic area, I remind them of how this area was an issue for Apollo 13. I will ask, "Remember how procurement was an issue for Apollo 13?" Then I will add, "It may pay to partner with capable suppliers, work closely with and get to know them, and keep up-to-date contact information." Another follow-up activity would be to give individual students a similar exercise on another film clip case.

This assignment is applicable to other courses, besides project management. Courses where project management is but a single topic, slated for as little as one week's coverage, include introduction to IS, systems analysis and design, and IS strategy and policy. Because the PMBoK areas provide for breadth of topical coverage, and the third, problem-solving, outcome provides depth, the failure is not an option activity could be implemented for a suitable introduction to project management in these other courses.

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Appendix

PMBok Area "project ____ management"	What I say in class	Issues identified by teams
scope	all the work that needs to be completed	return the spacecraft to Earth using minimal power (60 down to 12 amps)
schedule (time)	how long it takes to complete the work	get astronauts back to Earth before they run out of power (45 hours? 16 hours?)
cost	how much money it takes to complete the work in the time allotted	Money resources were not a problem in big, well-funded gov't project, but there was little time to allocate new or special funding for this emergency project w/limited scope
quality	how <i>good</i> the product or result is, in terms of satisfying the sponsor, mostly	Bring spacecraft back with astronauts alive and in one piece
communication	exchange of information among people involved	the separation of engineers and astronauts required remote audio communication with delayed responses
risk	projects are unique, therefore risky, can fail	the astronauts could die
resource	the people and materials needed to complete the work	time pressure on engineers, life/death pressure on astronauts to execute plan, using only resources available on tiny spacecraft
procurement	outsourcing; bringing in resources from the outside to help	talking to contractors about how to squeeze power out of every system
stakeholder	people and groups affected by the project, in and out of the team	astronauts, engineers, contractors, Americans (taxpayers and patriotic citizens)
integration	the area that ties together the other areas; triple constraint is a concept that applies here	time dimension connected to scope, resource, and risk dimensions

Table 3 - PMBoK Active Learning Exercise Summary