

Teaching Information Assurance and Management in an Active Learning Environment

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Abstract

We discuss several active learning techniques for the Master's level course IASP 540 – Information Assurance and Management – at Mercy College. Research studies have shown that traditional passive listening to lectures does not do much to help student comprehension and retention of information learned in the course. Active learning techniques, including individual-based learning, collaborative learning and cooperative learning techniques have been proven to be successful in engaging students and improving students' skills as they become Information Assurance professionals in the future. Anecdotal evidence states that active learning pedagogies have generally been well received by the students in the course IASP 540. In the future, we would like to try out other relevant active learning techniques in this course and other Information Assurance and Computer Science courses.

Keywords: Information Assurance, Management, Active Learning, Student Engagement, Cooperative Learning.

Introduction

The field of Information Assurance (IA) is growing by leaps and bounds. In every sector of society, business and government imaginable, such as financial services, healthcare, education, hospitality, entertainment, to name just a few, IA has become a vital and integral component addressing matters of national security, consumer privacy, and protection of information. At Mercy College, IA, now renamed Cybersecurity, has become a very popular field of study, both at the undergraduate and the graduate levels. This paper focuses on one course in the graduate (Masters) program – IASP 540 – Information Assurance and Management.

The IA Body of Knowledge (IA-BOK) outlines the following major areas of study, as given in Table 1 (Cooper et al., 2010), and the fifteen (15) IA common security principles, as given in Table 2 (The Information, 2010).

1. Fundamental Concepts	1. Asset Management
2. Cryptography	2. Risk Assessment and Control
3. Security Ethics	3. Security Policy
4. Security Policy	4. Security Infrastructure
5. Digital Forensics	5. Access Control
6. Access Control	6. Security of Operation
7. Security Architecture and Systems	7. Continuity
8. Network Security	8. Compliance
9. Risk Management	9. Development Process Security
10. Attacks/Defenses	10. Physical Security
11. Secure Software Design and Engineering	11. Personnel Security
	12. Network Security
	13. Application and System Software Security
	14. Security Discipline
	15. Ethics

Table 1: IA Body of Knowledge

Table 2: IA Common Security Principles

Chatmon et al. (2010) argue that there is a discrepancy between the skills acquired by IA students and the skills required by organizations employing IA professionals. We agree with this argument and the need to bring the skills of the students closer to what they need to have in order to advance in their respective professions.

Several research studies (for example, Chatmon et al. 2010, Graaf et al., 2005, Pheeny, 1997) have shown that traditional passive learning, such as listening to lectures, reading books, etc., are not sufficient to increase students' retention of information as well as student enthusiasm in the course. These and other studies have shown that show that by applying active and collaborative learning, there will be improvements in:

- Information retention,
 - Student-faculty interaction,
 - Student-student interaction,
 - Academic achievements (i.e., grades),
 - Higher-level thinking skills,
 - Teamwork,
 - Attitude towards the subject and motivation to learn.
- (Chatmon et al., 2010).

We consider one course IASP 540 – Information Assurance and Management – in the Master of Science (M.S.) program in Cybersecurity (formerly known as Information Assurance and Security) at Mercy College, and we describe the active learning mechanisms we have implemented.

Active Learning

Several studies (for example, Bonwell and Eison, 1991, Paulson & Faust) have shown that active learning extends well beyond traditional lecture as the primary form of instruction in a classroom. According to Paulson and Faust, “active learning is, in short, anything that students do in a classroom other than merely passively listening to an instructor’s lecture.” Students are learning by doing. Paulson and Faust identify 30 different active learning techniques that could be employed in a classroom, and classify these various techniques into several categories, such as Individual, Share/Pair, Cooperative Learning, and Collaborative Learning.

The full list of active learning techniques is beyond the scope of this article. We list only those techniques that have been employed in the IASP 540 – Information Assurance and Management course at Mercy College.

Individual Learning

In this case, the active learning techniques are geared towards individual students. These techniques provide the instructor good feedback regarding the student’s comprehension and retention of the material presented in class, material read in the book, etc.

1. The “One-Minute Paper” paper has the students taking a blank sheet of paper, and in one (or two, maximum) minutes, write a response to the question that the instructor poses. The student(s) then share(s) the response with the instructor, and discussion ensues.
2. The Socratic Method is a very traditional, nonetheless useful method to get information on student comprehension and retention of information presented. The instructor asks a student a question. The student is expected to answer the question right away. If the student cannot answer, the instructor chooses another student, and proceeds until someone answers the question.
3. In the Wait Time Method, the instructor poses a question to the entire class and then pauses for about 15 seconds, which seems like a really long time to the whole class. It is important for the instructor, with a warning ahead of time, to discourage students from raising hands and volunteering during the wait period. In this way, all students are forced to think about the answer to the question. When the wait time is up, the instructor calls upon a student to answer the question.

Collaborative Learning

Collaborative learning is a form of group instructional activity where all the group members are on equal footing, including the instructor. Some researchers (for example, Paulson and Faust) describe this method as a radical departure from tradition. Nevertheless, it forms a useful exercise with the instructor and the students both becoming teachers and learners at the same time.

Cooperative Learning

Cooperative learning is another form of group instructional activity where group members become responsible for a portion of the work they have chosen and, later, put the different parts together to get an integrated project. This is especially useful in complex term projects. Johnson, Johnson, & Smith (1991) note — “A crucial difference exists between simply putting students in groups to learn and in structuring cooperation among students. Cooperation is not having students sit side by side at the same table to talk with each other as they do their individual assignments....To be cooperative, a group must have clear positive interdependence, members must promote each other’s learning and success face-to-face, hold each other personally and individually accountable to do his or her fair share of the work, use appropriately the interpersonal and small-group skills needed for cooperative efforts to be successful, and process as a group how effectively members are working together. These five essential components must be present for small group learning to be truly cooperative” (pp. iii-iv).

1. In the Think/Write-Share-Pair method, the instructor poses a question to the students. The students work in pairs thinking or writing about the topic, then share the information among themselves to hone the answer. Then they might share their findings with the rest of the class.
2. The Cooperative Groups and Active Review sessions are similar to the Think/Write-Share-Pair, except that it involves a larger group of students working together on the question posed by the instructor.
3. Working at the Blackboard in groups forces all the group members to be active and think on the spot about the problem at hand.
4. Debates are a very useful technique for preparing students to argue for or against a topic or issue at hand. Students are assigned to teams and are given a position to defend. They work in groups and defend their position and rebut any opposing arguments from another team with a different position.
5. Project Work is a classic cooperative learning exercise. Students work in teams over an extended period of time in the semester on a given or chosen topic.

Active Learning in IASP 540 – Information Assurance and Management

The IASP 540 – Information Assurance and Management is a one-semester 3-credit course at the Master’s level looking at IA from a management perspective. The course touches upon many of the IA topics listed in Table 1 and all the common security principles listed in Table 2. As such, it is a very heavy course.

Structure of the IASP 540 course

The structure of the IASP 540 course follows Figure 1, adapted from The Information Assurance Body of Knowledge, Version 1.8 (2004). The week-by-week schedule for the term as well as the student term project follow Figure 1. For the term project, students typically choose a non-profit organization, such as a church, a music conservatory, a library, etc. If the organization is big, such as the Boy Scouts or YMCA, they choose a small business unit in the organization. Some students choose small proprietorships, such as accounting or tax firms, bodegas, food restaurants, cafeterias, etc. In return for access to the organization, the students deliver a complete information assurance infrastructure report to the organization.

On the first day of class, students are assigned to groups (of 3 or 4) randomly through a lottery system. Students remain in their respective groups throughout the entire for purposes of the term project. In class, however, different groups are formed for certain topic discussions and the project groups are used for other topic discussions. This is to limit complacency within the group and also to ensure all students have a chance to actively work with all other students in the class.

This course – IASP 540 – is naturally geared towards active learning. Multiple active learning techniques listed above are implemented from day one of the semester in the course and continue until the very end of the semester. In every class, typically some time is spent in lecturing about the concept(s) and some time is done in active learning to reinforce the concept(s) learned.

1. Asset Identification and Baselining – the first step of the IA process begins with identifying all the assets in the organization. Typically we ask the students to individually prepare lists of assets in their homes that they would like to protect in case of a disaster, such as a fire, water damage, etc. This is typically done as a version of the “One Minute Paper,” usually done within no more than five minutes. Some students are very raw in their asset list preparations, while some students prepare comprehensive lists very quickly. As the instructor asks each student for one asset for the list and writes the asset on the blackboard (or whiteboard) (combination of the Socratic Method and the Wait Method employed here), the student engagement becomes more enthusiastic.

In a subsequent exercise, the Think/Write-Share-Pair strategy is implemented. Students are put into pairs to do the same asset identification and baselining exercise for a small organization, either real or made-up. The scenario is different – for example, a hospital (or a unit in the hospital), a pizza store, a bodega, etc. – but the students have help from their partners. They begin to discover what they know and what they do not know about the concepts as well as about the particular organization chosen for the exercise. They start to work together on the assignment. After the allotted time is over, three to four student pairs are called to the blackboard (or whiteboard) to put their asset lists on the board. As the lists get written, the entire class begins to participate in the process.

For the group projects, students will work in cooperative groups and construct comprehensive lists of the same. By this time, they are in a much better shape to do the job more effectively and retain the learned material over longer periods of time.

2. The Risk Assessment process employs several active learning mechanisms. First students learn about the concepts of risk identification and risk management. They are then put into pairs to work on the Asset Ranking worksheets, Threat Identification and Prioritization worksheets, Threat-Vulnerability-Asset (TVA) worksheets, and the Risk Assessment worksheets for both their home assets and the assets of the organization they chose in step 1. In all these exercises, calling groups or pairs to the blackboard (or whiteboard), active reviews by students and the Think/Write-Pair-Share methods work very well.

For the group projects, similar to what they did in step 1, students work in cooperative groups and construct the different worksheets they did to do the risk analysis. In addition, especially for the term project, students need to study some industry standards, such as NIST 800 series, ISO 27000 series, GASSP or COBIT in order to perform the gap analysis. This study is best done in cooperative group settings.

3. The development of the Security Policy and associated Procedures as countermeasures to the existing and potential threats is the most involved process and the one where students get actively engaged throughout the process. Discussions of these policies and procedures, with discussions of ethical issues, social issues, and legal issues impacting the policies and procedures becomes a truly interesting and fun exercise in the entire course.

Collaborative learning, where the instructor and students are on equal footing, can be readily found in these discussions. Multiple modes of active learning are employed in these policy and procedure development discussions over several weeks, one topic per week (such as Access Control, Physical Security, Personnel Security, Disaster Recovery and Business Continuity, etc. as given in Table 2). Sometimes, the instructor becomes the student, and the student becomes the teacher, even if it is for just 15 minutes.

Many a time, the students are asked to develop just one policy statement using the One Minute Paper method. Then there is a discussion of that single policy statement. Alternatively, the Think/Write-Share-Pair technique can also be used here, where students work in pairs developing the policy statement, enriching their knowledge base as well as providing guidance to one another in the process. The brainstorming of ideas and the construction of knowledge through these exercises yield fruits eventually. These techniques have proved to be very useful in students understanding the complexity of policy formulation.

Debates, especially as they relate to Security Ethics and Policy formulations, provide immense reinforcements to material learned. Especially when students are given a position they are not readily comfortable defending, it makes them work even harder or research even further into the nuances of the policy so that they can make their case. This active learning approach will ensure that the students do not forget the policy or the situation for a very long time.

By the time the semester ends and the students have been through a myriad of assignments and exercises involving active learning, and the extensive project that they have undertaken with a real-world organization, they have indeed developed a good security infrastructure for the organization they are studying, and in the process, developed numerous skills that they can with them to the industry as IA professionals.

Feedback

Anecdotal feedback has been highly positive and encouraging. Student responses are collected at the end of each semester. When asked about their experiences with the course and with the multiple active learning techniques used during the course, students had only positive things to say, such as:

“The course....and ... have made us feel accomplished.”

“It was a great experience.”

“Your classes and the discussions really helped me pass my CISSP, especially the Risk Management part.”

Some students had some mixed feedback. Although they had a positive feedback with regard to the learning, their negative feedback was primarily due to some dysfunction within the group. Another reason was, from some students' perspectives, the amount of work they had to do for the course.

The main finding thus far suggests that students found these active learning techniques useful. Most students had a feeling of being involved with the material throughout the semester and many felt that they improved their IA skills over the semester of the course.

This feedback is, however, preliminary. We have to design a more formal survey for our students for feedback. We have to use pre-and post-tests to test these and other, as relevant, active learning techniques. We will collect and analyze the data, and report them in the future.

Conclusions and Future Plans

We have discussed several active learning techniques for the course IASP 540 – Information Assurance and Management – at Mercy College. Active learning techniques have generally been well received by the students in the course. In the future, we would like to try out other relevant active learning techniques in this course. Also, we would like to try these and other relevant active learning techniques in other IA as well as Computer Science courses. At the same time, these techniques should be tested in directed research courses as well as faculty-student research projects.

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Figure 1:
Relationship of the
15 Common
Security Principles

