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Professional Applications of Peer Leader Techniques

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Abstract

This paper provides an example of the required technical and professional skills that an apprentice learned in a building automation workplace, where I was the mentor and trainer. The experiential learning of the trainee through the guided transfer of skills was assessed by my observation and the trainee's reflections processed in Work Performed Reports. The Work Performed Reports are influenced by an exercise I implemented as an undergraduate Peer Leader. While an undergraduate, I served as a Peer Leader in an Electromechanical Engineering Technology program for a practical hands-on course on how to construct the box holding electrical components, called a "digital trainer." Toward the end of each class session, the instructor and I implemented a five-minute written exercise in which students answered process and technically-oriented questions drawn from the manual. The purpose was to encourage reflection on the task for that session. This paper describes the application of the technique of reflection I implemented as a Peer Leader and demonstrates that the attributes of PLTL can be applied in the workplace after the university experience.

Key Words: Reflection, Work Performed Reports, Building Automation, Technical, Professional, Safety

Peer leading in Electro-Mechanical Technology

The first-level course in the Electro-Mechanical Technology program at New York City College of Technology ("City Tech"), City University of New York (CUNY) incorporated a peer-led workshop in the 2013-2014 academic year. In this first-level laboratory course in Electrical Mechanical Technology (EMT 1130), students build an electronic "digital trainer," a box that contains rudimentary electronic components. The students begin by measuring, cutting, and bending sheet metal to the specifications in the course manual (visual and sequential steps). Following the sheet metal procedure, students input components; they will use these components later to test the functionality of the electronic trainer. After installing the components, the students begin to solder the wiring, connecting the components together. At the end of the semester, the box is tested for function by turning the various components on and off which light the seven LEDs (Light Emitting Diodes) on the box. The students will then use their digital trainer in the next-level class, Digital Control (EMT 1250).

The EMT 1130 course, which meets once a week for 2.5 hours, is a prerequisite for Electronics (EMT 1255) and Digital Control Lab (EMT 1250). This series of introductory classes is where the students learn about the components and the "how" of the box's operation. Although the Instruction Manual (in EMT 1130) does mention the components, it does not elaborate on how these components operate in the functioning of the box's inner circuitry. Students performed the tasks of building "the box" but did not seem to understand how the components worked to operate the box. What type of exercise would help students to focus more on the concepts of the electronic circuitry while also learning about machine shop "etiquette" and safety concerns?

I observed that students would complete a task, following the instructions, without considering why the specific step was necessary. As a Peer Leader in EMT 1130, I recognized that when I took this course I had performed in the same way. However, in taking more advanced classes, I realized that connecting the task with the concept would be helpful.

Jolly & Radcliffe (2000) note that engineering students need to be well-rounded professionals, able to communicate effectively with team members, observers, and facilitators. Avoiding reflection precludes the opportunity to learn the language of engineering, understand its logical organization, and the chance to practice it.

One way to accomplish this was through a "quiet" period of reflection at the end of class (Pinkhasik, 2015). Although one does learn quite a lot using practical methods, I suggested to the instructor that writing about it would supplement learning. If I could describe what I did during my task in words, I would understand the process better.

Toward the end of each class session, the instructor and I implemented a five-minute exercise in which students reflected on their task for that session by answering process and

technically-oriented questions drawn from the manual. As the semester progressed, the questions became more technical and safety-based. (See Appendix for the exercise questions).

Automation systems in buildings

The building automation field is broad and encompasses various engineering disciplines. Building automation systems contain complex contents, including building structure, building equipment, and building service and management. As an important part of an "intelligent building," building automation control systems include air conditioning systems, firefighting systems, power transformation and distribution systems, water supply and drainage systems, lighting systems and security monitoring systems, and each system plays a significant role (Yu, 2021). A Controls Technician with experience in a variety of building systems guides those new to the field so they can become proficient in the systems involved in building automation systems and how they are integrated. As a result of training, the new practitioner will be able to communicate with colleagues, execute a variety of different tasks, and follow safety guidelines at each job site.

During the PLTL experience with the students, the questions I presented to them to answer were similar but repetitive. The questions were about the process they used to complete their objective, as well as a technical question, and a safety question. Repetitive questions would allow students to find a pattern which could help them develop a solution, ask the right question, and solidify a theory they may have thought about. The same plan could be applied to develop a beginner Controls Technician.

Developing technical and other professional skills is a repetitive cycle, built up each workday. This repetition over time helps those new to the field recognize patterns that make sense to them. The ongoing repetition is guided by an experienced practitioner who is able to communicate what made them successful in the field. Success can be defined as leaving the building automation system functional after the work is performed and the job is completed.

The trainer is responsible for cultivating a learning environment for the trainee so they can observe many ways to complete the same task no matter what the worksite or work environment. From all the possibilities, the trainee can find the most efficient and productive way to accomplish their tasks and leave the building automation system functional. After the trainee is confident enough to perform the work independently, they will have basic knowledge of technical, communication, and safety skills. This will allow them to complete basic tasks with some supervision. As they progress through their employment stages, these skills will consistently be developed. Each day the trainee will continue to observe their colleagues, execute tasks, and follow safety guidelines.

Technical skills

Control panels contain a power supply for devices and controllers. Usually, panels are redundant to be uniform unless there is a need for a specific device. During each site visit, the trainer explains or reviews the anatomy of the panel and the devices that are monitored and controlled by the electronic controller.

As a learning process, the trainee explains the function of the parts in the panel at the job site. This will help build familiarity with nomenclature, power requirements, and purpose for each device.

The trainer shows how to run wires and label them inside the panel. The objective is to leave the panel organized and detailed. Wires leading to sensors should be labeled on the wire: e.g., Outside Air Temperature Sensor. Wires leading to actuators should be labeled on the wire: e.g., Outside Air Damper Actuator. This allows any technician to understand the control panel without any difficulty.

The trainer shows the trainee how to find information pertaining to devices found on the job site. Although technical drawings sometime show "perfect" situations of where to mount devices, technicians must use their expertise to mount them in the near "perfect" locations. For example, if the trainee is working with a specific brand of devices, the trainer helps the trainee navigate the manufacturer's website to find the device's specifications.

In the HVAC (Heating, Venting, Air Conditioning) controls industry, there is uniformity in wiring devices. For example, Red is for a 24Volts AC/DC Hot, Black is for 24Volts AC/DC Neutral/Common, White is used for temperature input, Green is used for Humidity input, Blue is used for CO_2 input. The trainee begins to see the pattern in each HVAC panel.

The trainee needs to gain an understanding of how devices function prior to troubleshooting devices. As the trainee observes the trainer working on a device, the trainer will consistently inform the trainee of the function of the device, what voltage is needed to power the device, what voltage is output from the device.

Professional skills

The development of professional skills is to familiarize the trainee with the functions of a job site, with knowledge of personnel and their job titles, and how these titles and functions fit together. The trainee observes how the trainer communicates with sub-contractors. The trainee then is asked to explain the various job titles and how those positions are pertinent to the project. The trainee develops an understanding of the importance of time assessment and constraints for work production, the implications of assessing risk versus reward, and the need for constant communication.

The objective for each project is to complete all the tasks in an efficient and safe manner. Unless a particular task has a stated priority, tasks that can be done fairly quickly will be done first. By doing tasks themselves, the trainee will understand how long tasks take and adjust the amount of time in the course of a day accordingly. After some time, the trainee is able to prioritize tasks to finish a day's work in a productive and more efficient manner.

The trainee observes how the trainer communicates with sub-contractors. If sub-contractors are contracted to perform the physical work, the trainer will show how to lay out tasks and advise on how to finish the day's work in a productive manner.

The Work Performed Reports (WPR) are used to document the tasks for the workday. The WPR contains the date, job site, existing issues, issues that were fixed and how, and tasks completed. The trainer evaluates the day's report to see how the trainee progresses. The trainee becomes aware of the processes by writing, and this awareness through repetition enhances their subsequent ability to verbalize and communicate specific information to others involved in the work site.

The WPR are similar to the reflection activity implemented in PLTL. As the students complete each weekly exercise, the exercises allow students to articulate on paper what they did throughout the class session. As they write down the process they execute to complete the task, they reflect on the steps. This could help the student visualize the process, determine whether the steps they used were correct, and whether there could be a more efficient solution.

Safety

Safety is paramount at each job site. The trainee observes that safety is required for each task. This emphasis is supported by the consistent procedure that prior to beginning each task, the trainer points out risks and issues that may occur if proper safety procedures are not followed. The trainee observes how to wear the proper PPE (Personal Protective Equipment) such as safety glasses, gloves, and hard hats when mounting devices, cutting holes in metal, and handling wire. They observe electrical safety, ladder safety, and mechanical safety. Prior to each task, I would remind a trainee of dangerous points such as a pipe leak, loose wires, hanging sheet metal, or pinch points.

Example of a job site: Activities

Each week I composed a field report for my project manager and operations manager of what the trainee observed regarding the objective of the worksite, and observations about the trainee's technical, safety, and "soft" or professional skill. An example is presented here:

Work Objectives at Building [location]

1. To install pitot tubes and run pneumatic tubes

2. Mount Return Air temperature/Humidity/ CO2 sensor and wire
3. Wire in B-1 Variable Frequency Drive
4. Replace steam 1/3rd and 2/3rd actuators in chiller pump room
5. Wire in steam 1/3rd and 2/3rd actuators and test
6. Mount Outside Air Temperature/ Humidity/ CO2 sensor

Technical Skills

1. How to wire up a supply and return fan Variable Frequency Drives
2. How to remove existing pneumatic steam actuator
3. How to mount actuators on a steam valve
4. How to wire actuators
5. How to verify actuators responded to command
6. How to mount OAT/ HT/ CO2 sensor outside

Professional Skills

1. Site hierarchy: Building engineers, Maintenance Personnel
2. Point-to-point testing requires two partners: one to send command, one to observe functionality

Safety Skills

1. +Stop VFD prior to disconnect to allow it to ramp down
2. Cut power to unit prior to working on any high voltage devices

Transfer of knowledge in example

In the field report example above, the objectives that consumed most of our time were wiring of the VFD (Variable Frequency Drive). The method I used to transfer my knowledge to my trainee, Samuel, was first by showing him the way I perform the task. As I performed the task, I said out loud what I was doing and what I was about to do. After the task was done, I supplemented what I did with the theory and data sheet for the device. Samuel was allowed to perform the task unless he did not feel confident in what he was doing. If the trainee does not feel confident at any given step, the trainer performs the task until the trainee is comfortable.

(1) When we wired in the VFD, I explained how to power down the VFD first due to safety and equipment safety
    1. Stop the VFD, let it ramp down to complete stop
    2. Turn the power off at the disconnect
    3. Take the VFD covers off
    4. Terminate wires here for start and stop of VFD
    5. Terminate wires here for speed modulation of VFD

6. Terminate wires here for VFD status
7. Terminate wires here for Safety Interlock
8. Test VFD

I showed Samuel the wiring diagram or data sheet so he could review how I wired it. Then I called the manufacturer's technical support to verify I was correct. I explained the voltage needed for the device to start/ stop, and speed modulation. When we tested the VFD, one person stood at the controller and the other at the VFD. When one person gave a command to the system, the second person confirmed that the VFD took the command and responded. We alternated testing positions so that the trainee can observe what each position entails. After the tasks were completed, I reviewed how the device worked and the essential "big picture" of how the device worked in the system much like I instructed my students to do as a Peer Leader to reflect on the day's learning.

Reflection

Using the Work Performed Report, the trainee can communicate with colleagues such as Project Managers (who are responsible for the job), Project Engineers (who design the job), and other colleagues pertinent to the job site on what they completed that day.

Through the practice of reflection, the student can utilize reflection-before-action, reflection-in-action, and reflection-beyond-action in the performance of tasks. Reflection-before-action would allow the student to prepare for the task, reflection-in-action would connect theory and practical knowledge, and reflection-beyond-action would allow the student to assess the steps they took to complete their task (Edwards, 2017).

The act of transferring thoughts to paper into words may lead to higher levels of abstraction and analysis. By requiring the trainee to write a daily report, their technical writing improves and they become more familiar with the nomenclature. It also allows them to reflect on their tasks for the day and how they completed them. It allows them to break down the tasks into steps. They can use this time to analyze how they completed the task and if there are more efficient ways to complete the task next time. The WPR also allows collaboration and tracking of the trainee's progress and examination of how they interpret instructions.

Safety, technical skills, and professional skills can be developed through the use of reflection-in-action and reflection-on-action while completing tasks and the work performed report.

Trainer's report on trainee

At the end of the training period with Samuel, I provided a report on my trainee to my operations manager. It provided an insight into how I trained Samuel and why.

> Over the two months of training, Samuel developed his technical, "soft," and safety skills. After showing him how I performed various tasks, he began to execute them without my help. He is driven to complete as many tasks as possible. I would say he is very familiar with the hand tools we use for panel work, wiring actuators, wiring VFDs, and mounting devices. He is mainly interested in the tasks at hand. While I worked with him on tasks, I always stressed the aspect of production, risk versus reward, and safety. He has developed professional skills by simply observing how I communicate with others. I believe Samuel has great potential at this company. He is intelligent and learns quickly. He understands tasks and theories better when the why is explained to him. He mentioned when I was going over the equipment layouts, that he did not understand too much because I didn't say why we are monitoring certain points. Once I began to explain why, he began to retain more information and understand the big picture. Samuel is productive and willing to do the work.

Although Samuel did not consistently complete the WPR while in training, he understood they were important because of communication. Some project managers may require daily reports, weekly reports, and monthly reports. The project manager that Samuel was assigned to requested the reports daily. I wanted to instill the habit of writing daily reports so that the trainee would be accustomed to communicating frequently.

Conclusion

As a Peer Leader, I noticed safety, technical, and professional skills were important in building the "digital trainer" and students' need to understand what they were doing and why each step was important. Having an explicit method of fostering reflection stood out to me as an exercise to help articulate what happened in the course each time the class met. In my profession, we use Work Performed Reports to communicate what tasks were completed during the day. I used the Work Performed Reports to assess the trainee's progress. I evaluated his problem-solving, instruction reception, and technical writing skills through these reports.

The WPR, like reflection periods, allow mentors an insight into how the mind is developing (Pinkhasik, 2015). A senior colleague indirectly assumes a role to guide junior colleagues. I had the pleasure to guide junior colleagues as a Peer Leader and as a senior technician. I used the reflection and WPR to gain insight into how trainees organized their thoughts, their understanding of theory, and how they explained what they learned. In turn the reports allowed me to modify how I guided each specific individual to best serve their style of learning.

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Appendix

First Exercise

Q. 1. What have you built/constructed/done that helps you in your tasks in this class?

Q. 2. When you read the manual, what do you look at?

Q. 3. What was your task today? Was there a difficulty you faced?

Q. 4. If someone appears to get electrically shocked in close proximity what would you do?

Second Exercise

Q. 1. How can this reflective exercise develop your problem-solving skills?

Q. 2. What does the transformer do when the power plug is plugged into the outlet?

Q. 3. What is the schematic symbol for a transformer? (Use manual as reference)

Q. 4. What was your task today? If there was a challenge, how did you overcome it? (Be specific about task and use full sentences)

Third Exercise

Q. 1. What was your task today? If there was a difficulty, how did you overcome it?

Q. 2. What can be the benefits of working together rather than working alone?

Q. 3. Where there any topics or steps that were unclear coming to this point?

Q. 4. What type of materials are found in a class A fire? (Use manual as reference)

Fourth Exercise

Q. 1. If you had the opportunity to fix any part of the manual, what would it be and how would you word it so that future students would be able to understand word for word what you mean?

Fifth Exercise

Q. 1. Describe in detail what steps you have to take to construct your digital trainer

Q. 2. Where do you find how to connect the ribbon cable wires for your digital trainer?

Q. 3. What would you do upon noticing a burning odor coming from your digital trainer after plugging it into a wall outlet power source for testing?

Q. 4. Why should you wear protective goggles/safety glass at all times in the lab?

Q. 5. How and where do you go for help in any aspect of constructing an electronic device?