Learning outcomes as a self-evaluation process

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Learning Outcomes as a Self-evaluation Process

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Abstract

Learning outcomes are measurable statements that can be used to identify what the students should be able to do and know at the end of the course or class. These learning outcomes are stated in the course syllabus and are reviewed by the students at the beginning of the course. However, normally the students do not review them frequently during the semester.

In 2022, a detailed list of learning outcomes was defined for the Introduction to Cyber Security course for Majors. This list includes a granular set of outcomes that students should achieve after each class of the semester. Using the Learning Management System (LMS), these outcomes are included in each week's module and are also reviewed at the beginning of each class. In this way, students are constantly in contact with this information.

This paper presents the results of a survey that evaluates the student's level of awareness of the learning outcomes. This survey is applied at the end of the semester. Also, it presents preliminary results of the student's self-evaluation of their level of accomplishment of these learning outcomes. For this, during the spring of 2023, students will self-evaluate their level of development of the learning outcomes proposed for the week.

Introduction

As educators, we consider that is important to allow the students to be aware of the learning objectives of each class session, these learning outcomes have the goal to inform the students about the knowledge and skills they will acquire during the course. This will allow the students to participate more actively in their learning process.

Having well-written learning objectives also helps the teachers to align the assessment tools and teaching methodologies with the topics of the courses [1]. These learning objectives should follow Bloom's Taxonomy, which defines a hierarchy of six levels in the cognitive domain where the objectives focus on recognizing knowledge and developing intellectual skills [2, 3].

The author of [4] presents a study about the students' motivation and how it can influence on learning outcomes of the courses. Having a good environment, engaged and motivated students and positive relations between the teachers and students helps them to achieve learning outcomes more easily and productively. The author states some reasons why having well-designed learning outcomes is important. First, they can give more transparent knowledge about what they have to learn during the course. Second, the employers have a better understanding of the capacities of future recruits, and finally, help in the design of quality courses.

A good definition of learning outcomes in a course can be an indicator of the success of the course because they present a clear idea of what is needed to be achieved at the end of the course and can also guide the student's career path [5].

Some studies corroborate the hypothesis of the importance of having learning outcomes well-defined in the courses. Authors of [6] present a study that suggests that students find learning outcomes useful, but they also found that sometimes the students are not able to link the learning outcomes with how much they need to know to cover their topic area or to pass an assessment.

Another important reason why is needed to have well-defined learning outcomes is the accreditation process. Several programs all over the world use the student learning outcomes data for the evaluation process for accreditation [7]. More specifically, the accreditation agencies require that the programs show how they are using the results of the students learning outcomes to improve the courses and therefore the program [7, 8].

This study reports the student's level of awareness about the learning outcomes of two courses in the Cyber Intelligence and Security program. The work compares how different the level of awareness is when comparing groups of freshmen vs juniors/seniors students. Future research will try to find a correlation of awareness with the performance of the students.

Learning outcomes vs learning objectives

Some authors use the terms learning outcomes and learning objectives interchangeably. However, they have some important differences [9].

The instructor normally defines learning objectives during the curse design. They are based on the teacher's expectations about what the course can offer to the students. These objectives describe what students will be expected to learn in the course. Learning objectives can be defined at different levels of granularity they can be defined at the level of the lesson, the unit (group of lessons), the course, the academic year, or the program. According to the level, these learning objectives can be broader and more generic (course/year) or more specific (lesson).

Learning outcomes are defined from the perspective of the student. They define what the student will learn. This can be evaluated by the same student as a measure of their knowledge level in the different topics of the course.

The definition of learning outcomes will help students to make better and more informed decisions about how the course fits their future academic path, they will help the student to identify what knowledge is needed to have a good experience and be successful in the class, and more importantly, to have taken control of their progress and be aware of what they are learning.

In this work, we are using the definition of learning outcomes, specifically due to the focus of the term: the student's perspective. With the learning outcomes, it is possible to have a more effective course that centers on the student's learning process. Also, gives the teacher the possibility to know how to assess the student's knowledge and based on the results how to change and improve the teaching methodologies used.

Study of students' perception of learning outcomes

The study presented in this section is contextualized in the course CI-120 Introduction to Cybersecurity for majors a freshman-year course and the course CI-450 Computer Forensics II, a junior-year course. Both courses are part of the bachelor's program in Cybersecurity offered at Embry-Riddle Aeronautical University, Prescott Arizona Campus.

The study compares the level of awareness and importance students give to the learning outcomes of their classes. For this, the faculty member has defined a detailed set of learning outcomes for each class in both courses. This information is posted in the weekly module available for the students in the Learning Management System LMS and it is also presented by the professor at the beginning of each class. In this way, the students are aware of the proposed goals for each session. An example of the learning outcomes defined for each course is presented in Figures 1 and 2.

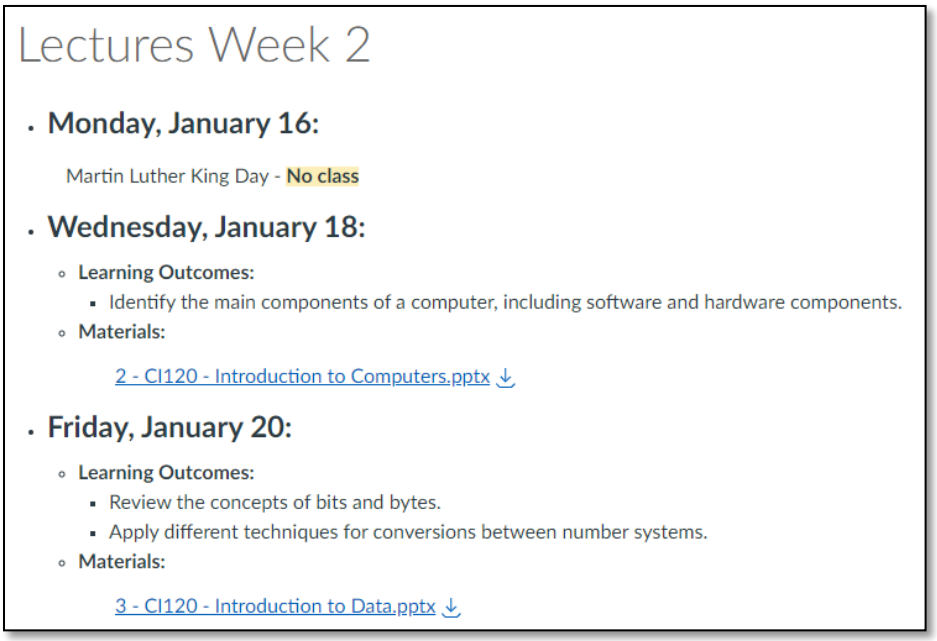

Figure 1. CI-120 Learning outcomes Week 2 Sessions

In week 7 of the spring semester of 2023, the students for both courses were asked 2 questions anonymously. The first question was to answer YES or No. The second question was answered based on a scale of importance from 0 to 5.

- Question 1: Have you read the learning outcomes defined for each session that are available in your LMS?

- Question 2: On a scale from 1 to 5, (1 not important, 2 not that important, 3 somehow important, 4 important, and 5 very important), how important do you consider it is to know the weekly learning outcomes of the course?

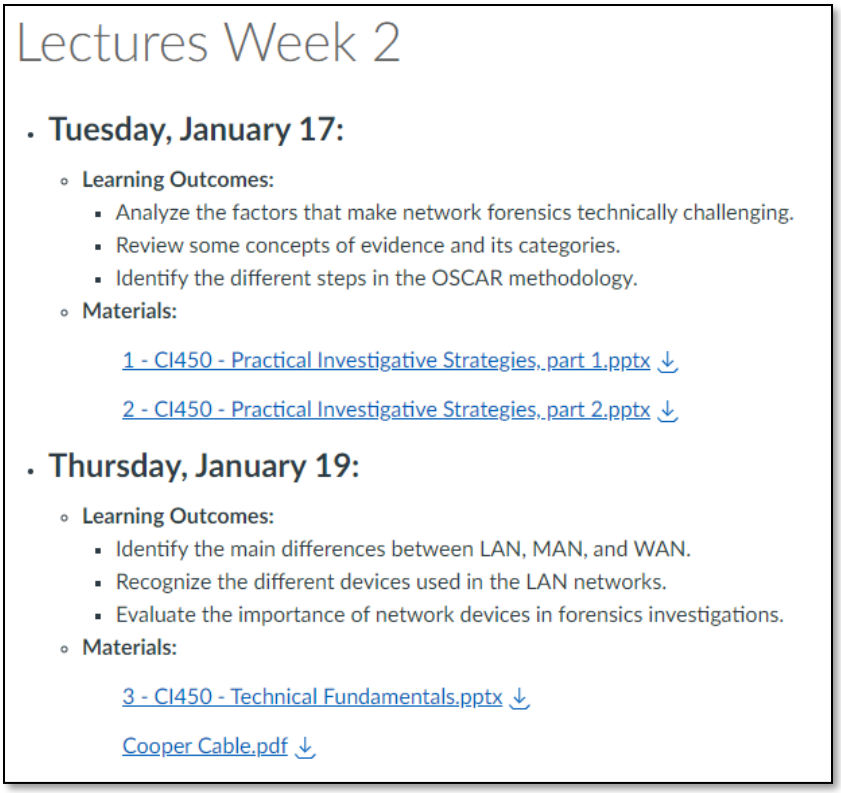

Figure 2. CI-450 Learning outcomes Week 2 Sessions

Table 1 presents the scale levels for question 2 answers. The aggregated results of the answers of the 13 students of the CI-120 course are presented in Tables 2 and 3.

Table 1. Scale levels for question 2 answers

Answer number for question 2	Scale level
1	not important
2	not that important
3	somehow important
4	important
5	Very important

Table 2. Results for question 1 for the CI-120 course

	Answer YES	Answer NO	No Answer	Total Students
Question 1	8	4	1	13
Percentage	61.5%	30.7%	7.7%	

Table 3. Results for question 2 for the CI-120 course

	Answer 1	Answer 2	Answer 3	Answer 4	Answer 5	No Answer	Total Students
Question 2	1	0	5	4	2	1	13
Percentage	7.7%	0%	38.5%	30.8%	15.4%	7.7%	

The aggregated results of the answers of the 40 students of the CI-450 course are presented in Tables 4 and 5.

Table 4. Results for question 1 for the CI-450 course

	Answer YES	Answer NO	No Answer	Total Students
Question 1	33	5	0	38
Percentage	86.84%	13.16%	0%	

Table 5. Results for question 2 for the CI-450 course

	Answer 1	Answer 2	Answer 3	Answer 4	Answer 5	No Answer	Total Students
Question 2	0	4	13	9	12	0	38
Percentage	0%	10.53%	34.21%	23.69%	31.57%	0%	

As shown in Table 2, the results for question 1 for the CI-120 course were that 61.5% of the students read the learning outcomes that are published on the LMS, 30.7% do not read the learning outcomes that are published in the LMS and 7.7% (1 student) did not answer the survey.

Now, in Table 4, the results for question 1 for the CI-450 course were that 82.5% of the students read the learning outcomes that are published on the LMS, 12.5% do not read the learning outcomes that are published in the LMS and 5% (2 students) did not answer the survey.

As shown in Table 3, the results for question 2 for the CI-120 course were that 7.7% of the students think that is not important to know the learning outcomes of each session, 38.5% of the students think that is somehow important to know the earning outcomes, 30.8% of the students think that is important to know the learning outcomes, 15.5% of the students think that is very important to know the learning outcomes of each session, and 7.7% (1 student) decided to not answer the survey.

Now, as shown in Table 5, the results for question 2 for the CI-450 course were that 10% of the students think that is not that important to know the learning outcomes of each session, 32.5% of the students think that is somehow important to know the earning outcomes, 22.5% of the students think that is important to know the learning outcomes, 30% of the students think that is

very important to know the learning outcomes of each session, and 5% (2 students) did not answer the survey.

Analysis of the results

Our initial hypothesis was that students who have been more time enrolled in the bachelor program would be more interested in reviewing the learning outcomes of the course lessons and that freshman students would not be as conscious of the importance of having this information.

The results showed that our hypothesis is initially corroborated by the results. Combining question 2 answers 4 and 5 (important and very important) in both classes, we can get the results of 55.26% of the students in the CI 450 course (junior/senior level students) think that is important to have learning outcomes available for each week, and 46.2% of the students in the CI 120 course (Freshman level students) think that is important to have learning outcomes available for each week.

In question 2 answer 1 (not important), we found that none of the students in the CI 450 course selected this answer, in the CI 120 course (freshman level students), 7.7% of the students find it not important to have learning outcomes defined in the course.

As we can see, there is a slightly bigger awareness sense of the importance of having learning outcomes for the classes in the junior/senior level students than in the freshman level students. This can be because higher-level students have more experience in the dynamic of the university, they are more aware of the importance of having well-defined learning outcomes and are more aware of what they should learn to be successful in their careers.

However, more research and studies need to be conducted to state that junior and senior-level students value and take more advantage of the learning outcomes of the courses. Many factors can play a role in getting different results in this type of study, for instance, if the freshman students had previous experiences in K-12 making a conscious review of learning objectives and outcomes defined for their courses.

Some of the comments provided by the students in the CI-120 course were:

- “I believe that they are important and they highlight the main learning objectives of the course material”

Some of the comments provided by the students in the CI-450 course were:

- “Knowing learning outcomes ensure I focus on the right things”
- “They help give a better understanding & you can use them to identify knowledge gaps”
- “It is very nice to know what to expect and how to prepare”
- “Knowing the outcomes is helpful in knowing what we need to understand but not as important as the content itself”

Based on the comments, we can see that more junior/senior level students expressed how helpful and important is a good definition of learning outcomes for establishing their goals for the course and for defining their study plan for the course.

Conclusions and Future Work

A correct definition of the learning outcomes is crucial for the students to make more effective use of them during their learning process in the courses.

Technological tools such as LMSs help substantially in the management of the learning outcomes definition. They also help in its publication and evaluation week by week or lesson by lesson, making it easy for the students to have them on hand when needed.

The number of enrolled students in the CI 120 course for the Spring 2023 semester was only 13 people, compared to the 40 students enrolled in the CI 450 course. Therefore, more studies need to be conducted in different courses with a bigger population of students to determine the real impact of the awareness of learning outcomes on the level of learning of the students.

For future work, we have three lines of research:

1. Find a possible correlation between awareness and the performance of the students.
2. Identify the correlation between the level of confidence the students have in a topic and their performance during the quizzes and exams of the courses.
3. Find a possible correlation in the level of awareness of learning outcomes between students from different colleges.

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