

# University of Puerto Rico at Bayamón

## Continuous Improvement Report Information Systems 2019-2022 Cycle **September 2024, Revision**

This report provides the analysis of the Student Outcomes achievement level, for the Information Systems emphasis area of the Computer Science Department

## A note about the Updated Student Outcomes

The Computer Science program aims to be re-accredited by the Computing Accreditation Commission (CAC) of the Accreditation Board of Engineer and Technology (ABET). The document Criteria for Accrediting Computing Programs for those programs effective for review during the 2024-2025 Accreditation Cycle clearly stipulates on page 4: *The program **must** have documented and publicly stated student outcomes that include (1) through (5).* Furthermore, a sixth student outcome is required for the *Information Systems and Similarly Named Computing Programs*. This revised document includes the updated student outcomes.

## Information Systems Program - Student Outcomes Data Analysis

The analysis was performed using triangulation. The tools used were: the post-test (direct), the exit survey (indirect). If there was a difference that entailed seeking more information, then, data from the courses was used. There were outcomes that were not measured on the post-test, therefore, data from the courses and rubrics were used to gather information.

As in previous cycles we used the results from the post-test questions for further analysis. The analysis assumed the following scale:

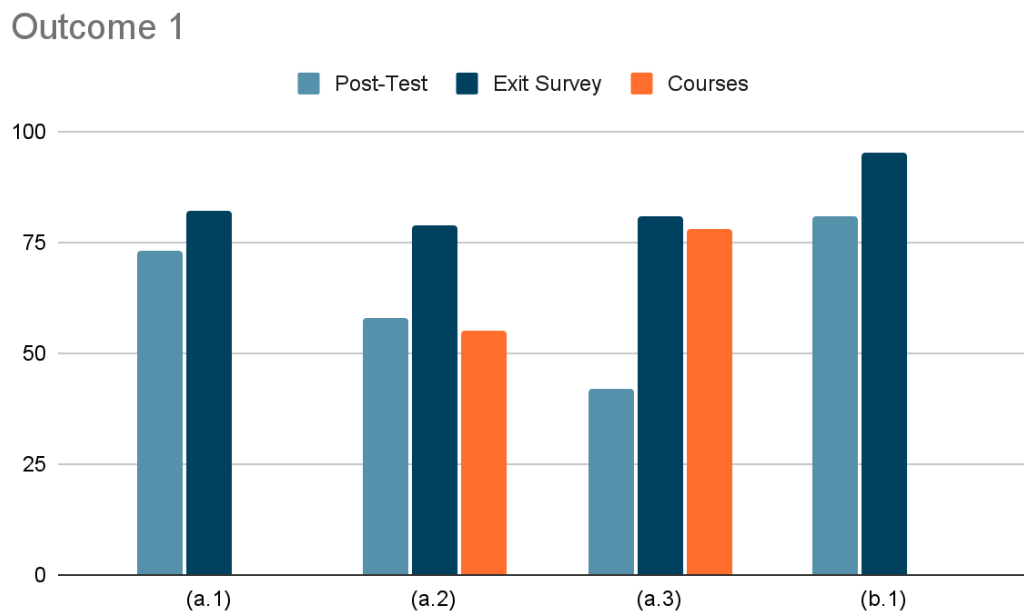
- Satisfactory – the question was correctly answered by at least 75% of the students.
- Developing – the question was correctly answered by at least 50% of the students but less than 75%.
- Unsatisfactory – the question was correctly answered by less than 50% of the students.

For the student survey, the analysis assumed the following scale:

- Satisfactory – the indicator was graded as A or B by the student.
- Developing – the indicator was graded as C by the student.
- Unsatisfactory – the indicator was graded as D or F by the student.

## Outcome 1: Analyze a complex computing problem and apply principles of computing and other relevant disciplines to identify solutions.

This outcome is measured by four main performance indicators. The following is an histogram that resumes our findings.



The PIs are the following:

(a.1) Select the appropriate algorithm for an specific situation

On average 73% of our students answered the questions related to this PI correctly. All the students that completed the exit survey gave this indicator a grade of B on average 82%. Therefore the AAC concluded that the achievement level for this PI was met.

(a.2) Analyze the asymptotic running time of algorithms using big-O notation

On average 58% of our students answered the questions related to this PI correctly. We considered these results to be very very low. However, all the students that completed the exit survey gave this indicator a grade of 79% (high C). Questions from Exam 2 from the course SICI 4036 Algorithm Analysis were analyzed. The mean grade obtained in these questions was 55% (fail). Therefore we conclude that this PI was not met.

(a.3) Apply mathematical concepts in the solution of a given problem

On average 42% of our students answered the questions related to this PI correctly. However, all the students that completed the exit survey gave this indicator a grade of 81%. Results obtained from the sample questions from Exam 2 and Exam 3 of the course SICI 4037 Data Communication from three

academic years were analyzed. These questions were questions 23, 24, 25 from exam 2 and questions 2 and 5 from exam 3. On average 79% of the students could answer the questions correctly. Therefore we conclude this PI was met.

#### (b.1) Analyze a problem

Only 81% of the students answered this question correctly. However, they show confidence in this PI on the exit survey since they graded themselves with 95%. Therefore, the AAC concluded that the achievement level of this PI was met.

## Previous Cycle Comparison

Performance indicator (a.1) have been met in both assessment cycles. However, there has been a decrease in the results of the post-test by -11%. Performance indicator (a.2) was classified as developing in the previous assessment cycle and as not met in the current assessment cycle. However there has been a 15% improvement on the results of the post-test that are related to this PI. There has been a slight increase of 2% on the results of the post-test related to PI (a.3). On both cycles we had to gather data from courses for PI (a.3). However, the PI was met in both cycles. Moreover, there has been a 13% improvement in the results of the post-test for PI (b.1) when compared with the previous cycle.

## Conclusions and Recommendations

We need to strengthen this outcome. We know that students have difficulties in math courses. They have expressed their frustration informally. However, we need to reinforce this outcome.

- Reflection on (a.2): We are very concerned that the performance indicator (a.2) continues to indicate low levels of achievement for IS students. CS students continue to outperform IS students on this indicator. However, CS majors strengthen the topics covered by (a.2) and (a.3) on courses COTI-4255 Analysis of Algorithms and COTI-4250 Theory of Computation. We need to reflect if we need to change these PIs for the students at IS. We have already suggested in the past that PI (a.2) be different for IS students. Perhaps, this PI can be rephrased and serve the intended purpose. This must be addressed as soon as possible.
- Recommendation on (a.3): Students are still failing on the post-test on this PI. We need to revise the post-test questions again. We have analyzed questions from the course SICI-4037 Data Communications for obtaining the achievement level of this PI. Therefore, questions related to this course could be those included in the post-test.

## Outcome 2: Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.

This outcome is measured by five main performance indicators. The following is an histogram that resumes our findings.



This PIs are the following:

(b.2) Identify and define the computational requirements needed in a real situation.

On the post-test 79% of the students answered the questions related to this PI correctly. All the students that completed the exit survey gave this indicator a grade of B (an average of 82%). Therefore, the AAC concluded that the achievement level of this PI was met.

(b.3) Choose the appropriate software and/on hardware tools to meet the desired goals

On the post-test 80% of the students answered the questions related to this PI correctly. Also, all the students that completed the exit survey gave this indicator a grade of B (an average of 84%). Therefore, the AAC concluded that the achievement level of this PI was met.

(c.1) Design solutions using pseudo code, diagrams or natural languages.

On the post-test just 33% of the students answered the questions related to this PI correctly. In previous cycles their performance was 50%. However, all the students that completed the exit survey gave this indicator a grade of B (an average of 84%). Since there is an abysmal discrepancy the committee decided to examine IS coursework and the drafting of the exam. The AAC in coordination with the professor who taught the Capstone course SICI 4038 took the task of analyzing (c.1) directly from the projects. The average score obtained from this analysis was 89%. The AAC concludes that this PI was met.

#### (c.2) Implement an algorithm using the appropriate programming language

On the post-test just 34% of the students answered the questions related to this PI correctly. All the students that completed the exit survey gave this indicator a grade of B (an average of 88%). After examining the projects students submitted to the capstone course (SICI 4038) the AAC concluded that students were able to implement a system in a variety of languages. We have seen many diverse capstone projects. Some of them are in different environments and paradigms such as: mobile, web development and more. This has been evident to us by analyzing the posters produced by the students on the capstone course. Therefore, the AAC declared that the achievement level of this performance indicator is met.

#### (c.3) Perform both unit and system testing

All the students that completed the exit survey gave this indicator a grade of B (an average of 84%). Since this PI cannot be measured in the post-test we decided to analyze data from the course SICI 4036 - Data Structures. Unit testing is an essential part of the homeworks of this course. Unit testing is embedded throughout all the courses. Students perform unit and system testing when building programs of varying complexity using JUnit and running it on Eclipse. A requirement of all the homeworks of this course is using JUNIT. Therefore, the AAC classifies this PI as met.

## Previous Cycle Comparison

There is no difference between the results obtained for the performance indicator (b.2) in both cycles. However, there is a 5% decrease in the performance indicator (b.3).

## Conclusions and Recommendations

Questions for (c.1) have to be revised on the post-test. It is evident that in the documents students prepare for the SICI 4038 course, as well as on the posters, we can see use case diagrams, state transition diagrams, flowcharts, ERDs, UMLs and also pseudocode to express some ideas. However, they keep failing on the post-test. Therefore, we need to conclude that the post-test needs a revision.

Questions for (c.2) in the post-test needed more analysis. The AAC reflected on this PI and decided that implementing an algorithm using the appropriate programming language is difficult to be measured precisely on the post-test. The post-test could reflect a glance about what they are thinking about it,

however, this skill can be analyzed more in-depth in our capstone course. However, the questions that measured this PI on the post-test need to be reviewed (or revised).

This outcome was met.

## Previous Cycle Comparison

We are still analyzing the results from course SICI 4019 Computer Architecture, however, we must analyze these results from the capstone course. The results obtained reflect changes after analyzing the results obtained from the rubrics of both cycles. There have been positive and negative changes. There is an increase of 12% for (f.1) , 8% for (e.2) and a change of -8% on (f.3). However, the AAC looks at the 12% of improvement of (f.1) with skepticism.

## Conclusions and Recommendations

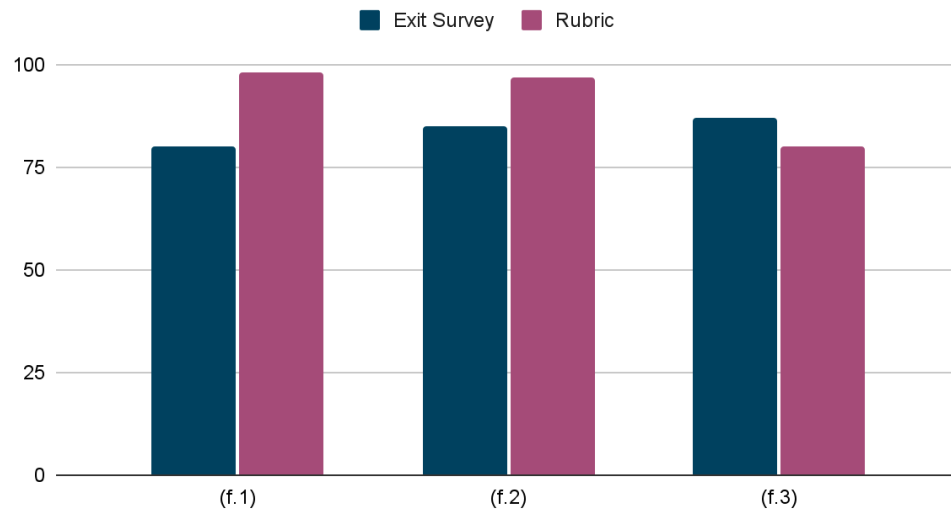
The outcome was met.

- Reflection: Skepticism on the results obtained from (f.1): The AAC is surprised with the results obtained from the rubric since their confidence level is very low. This can be seen when they give themselves a grade of 80% on the Exit Survey. However, the results obtained from the coursework reflects a higher level of achievement. Perhaps we need better measurement tools to analyze (f.1). In addition, some students are afraid to present orally, but not in writing. The language barrier, especially on our island, can also make them feel, at the time of answering the Exit Survey, that they do not feel safe speaking in one of the two languages. The AAC speculate that it is the problem of our bilingualism (English). However, after analyzing their work, one sees that they are very good. The AAC realizes that there are tools available that aid them into improving their written work. This is true with the advent of AI. The AAC recommends that two tools be used to measure this PI in the future. We recommend the rubric used in the oral presentation, as an alternative for measuring (f.1).

## Outcome 3: Communicate effectively in a variety of professional contexts.

This outcome is measured by three performance indicators. The following is an histogram that resumes our findings.

### Outcome 3



The PIs are the following:

(f.1) Present different topics both orally and/or in writing

All the students that completed the exit survey gave this indicator a grade of B (an average of 80%). The AAC decided to analyze the rubric used by the professors for grading the SICI 4019 Computer Architecture Term Paper. Results were obtained from the 1th row of this rubric. The average grade obtained analyzing this row was  $3.95/4 = 98\%$ . Therefore the AAC concluded that the achievement level for this PI was met.

(f.2) Explain technical concepts using the correct terminology

All the students that completed the exit survey gave this indicator a grade of B (an average of 85%). The AAC decided to analyze the rubric used by the professors for grading the SICI 4019 Computer Architecture Term Paper. Results were obtained from the 4th row of this rubric. The average grade obtained analyzing this row was  $3.86/4 = 97\%$ . Therefore the AAC concluded that the achievement level for this PI was met.

(f.3) Display knowledge of technical report writing

All the students that completed the exit survey gave this indicator a grade of B (an average of 87%). The AAC decided to analyze the rubric used by the professors for grading the SICI 4019 Computer Architecture Term Paper. Results were obtained from the 5th row of this rubric. The average grade obtained analyzing this row was  $3.18/4 = 80\%$ . Therefore the AAC concluded that the achievement level for this PI was met.



## Previous Cycle Comparison

We are still analyzing the results from course SICI 4019 Computer Architecture, however, we must analyze these results from the capstone course. The results obtained reflect changes after analyzing the results obtained from the rubrics of both cycles. There have been positive and negative changes. There is an increase of 12% for (f.1) , 8% for (e.2) and a change of -8% on (f.3). However, the AAC looks at the 12% of improvement of (f.1) with skepticism.

## Conclusions and Recommendations

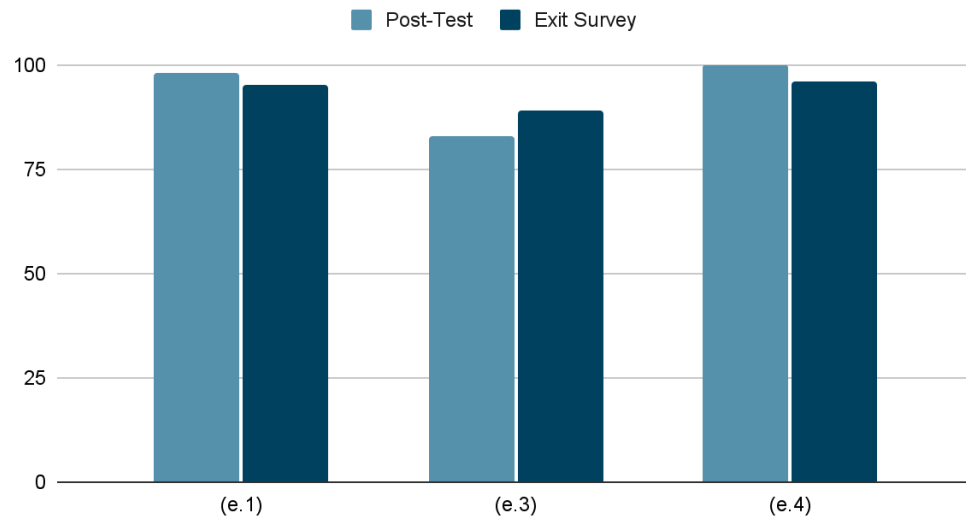
The outcome was met.

- Reflection: Skepticism on the results obtained from (f.1): The AAC is surprised with the results obtained from the rubric since their confidence level is very low. This can be seen when they give themselves a grade of 80% on the Exit Survey. However, the results obtained from the coursework reflects a higher level of achievement. Perhaps we need better measurement tools to analyze (f.1). In addition, some students are afraid to present orally, but not in writing. The language barrier, especially on our island, can also make them feel, at the time of answering the Exit Survey, that they do not feel safe speaking in one of the two languages. The AAC speculate that it is the problem of our bilingualism (English). However, after analyzing their work, one sees that they are very good. The AAC realizes that there are tools available that aid them into improving their written work. This is true with the advent of AI. The AAC recommends that two tools be used to measure this PI in the future. We recommend the rubric used in the oral presentation, as an alternative for measuring (f.1).

## Outcome 4: Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.

This outcome is measured by three performance indicators. The following is an histogram that resumes our findings.

## Outcome 4



The PIs are the following:

(e.1) Evaluate the ethical implications of an issue in the computing discipline

On the post-test 98% of the students answered the questions related to this PI correctly. All the students that completed the exit survey gave this indicator a grade of A on average 95%. Therefore the AAC concluded that the achievement level for this PI was met.

(e.3) Recognize the responsibilities inherent to the profession

On the post-test 83% of the students answered the questions related to this PI correctly. All the students that completed the exit survey gave this indicator a grade of B on average 89%. Therefore the AAC concluded that the achievement level for this PI was met.

(e.4) Evaluate the consequences when breaking the law

On the Post-test 100% of the students answered the questions related to this PI correctly. All the students that completed the exit survey gave this indicator a grade of A (an average of 96%). Therefore the AAC concluded that the achievement level for this PI was met.

## Previous Cycle Comparison

Performance indicator (e.4) was introduced in this assessment cycle following the recommendations obtained from the AAC. Therefore they could not be compared with previous results. The results obtained reflect a change of 8% for (e.1). Performance indicator (e.3) remains with the same results.

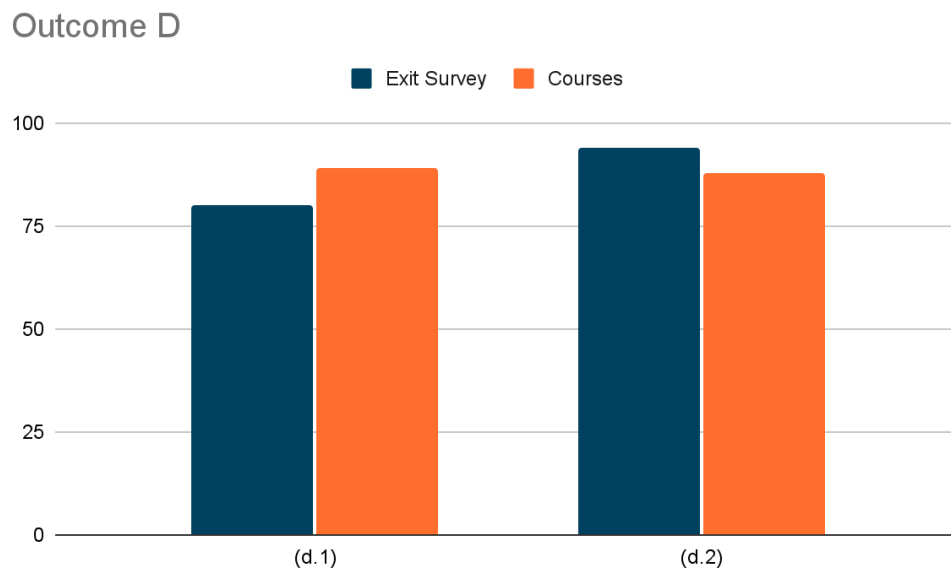
## Conclusions and Recommendations

This outcome was met.

The revision of the post-test included questions for (e.4) for the first time. We analyze this PI based on three semesters. We are very pleased with the achievement level of this outcome.

### Outcome 5: Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.

This outcome is measured by two main performance indicators. The following is an histogram that resumes our findings.



The PIs are the following:

(d.1) Evaluate a given problem within a team environment

All the students that completed the exit survey gave this indicator a grade of B (an average of 80%). Data from the course SICI 4037 Data Communication was analyzed using the Group Skills rubric. An 89% was obtained from analyzing items 1, 2, and 5 from the Group Skill Rubric. the AAC concluded that the achievement level of this PI was met.

(d.2) Perform duties assigned when working on team

All the students that completed the exit survey gave this indicator a grade of A (an average of 94%). Data from the course SICI 4037 Data Communication was analyzed using the Group Skills rubric. An 88% was obtained from analyzing items 3 and 4 from the Group Skill Rubric. the AAC concluded that the achievement level of this PI was met.

## Previous Cycle Comparison

The results obtained reflect an improvement of 13% in the indicator (d.1) and 12% in the indicator (d.2) when compared to the previous cycle. The results obtained in both indicators is greater than 80%.

## Conclusions and Recommendations

This outcome was met.

## Outcome 6: Support the delivery, use and management of information systems within an information systems environment.

This outcome is measured by five performance indicators. The following is an histogram that resumes our findings.

### Outcome 6



The PIs are the following:

(j.1) Analyze the information flow in an organization.

On the Post-test 58% of the students answered the questions related to this PI correctly. However, all the students that completed the exit survey gave this indicator a grade of B on average 87%. Since there is a discrepancy we have to dig further and analyze data from the courses. The professor who taught the Capstone course SICI 4038 took the task of analyzing (j.1) directly from the projects. The average score obtained from this analysis was 96%. The AAC concludes that this PI was met.

(j.2) Understanding the process operations within an organization.

On the Post-test 47% of the students answered the questions related to this PI correctly. However, all the students that completed the exit survey gave this indicator a grade of B on average 86%. Since there is a discrepancy we have to dig further and analyze data from the courses. The professor who taught the Capstone course SICI 4038 took the task of analyzing (j.2) directly from the projects. The average score obtained from this analysis was 93%. The AAC concludes that this PI was met.

(j.3) An ability to discern between a transactional-processing system, management information system, and decision support system.

On the Post-test 64% of the students answered the questions related to this PI correctly. All the students that completed the exit survey gave this indicator a grade of A on average 78%. Since there is a discrepancy we have to dig further and analyze data from the courses. Therefore, the AAC decided to analyze five questions from Exam #1 from the course SICI 3211. The average score of these five questions is 86%. The AAC concludes that this PI was met.

(j.4) Recommends viable solutions using computer systems as main solution

All the students that completed the exit survey gave this indicator a grade of A (an average of 87%). Our students have demonstrated this ability on the capstone course SICI 4038, the AAC concludes that this PI was met. Also, analyzing the projects in COTI 4430 Information System Project Management the students, the AAC concludes that this PI was met.

(j.5) Construct an Information System

All the students that completed the exit survey gave this indicator a grade of A (an average of 83%). Also, our students have demonstrated this ability to develop projects of varying complexity on the SICI 4038 course (our capstone course), the AAC concludes that this PI was met. Students have developed projects that span different environments (web, mobile, PC software etc) .

## Conclusions and Recommendations

The outcome was met.

It is important to notice that in (j.1) and (j.2) the information obtained from the post-test was low. Questions regarding these two outcomes are the last one from the port-test. Also, the questions to analyze (j.1) and (j.2) use the same diagram. This is a data flow diagram obtained from a textbook that the students do not use. We need to revise these questions.

Also, an improvement on the wording of performance indicators (j.1) and (j.2) was suggested in conversations between the AAC and the Information Systems Program Coordinator,. These recommendations were written and are currently being analyzed further.

## Criterion 5: Curriculum Assessment Tools

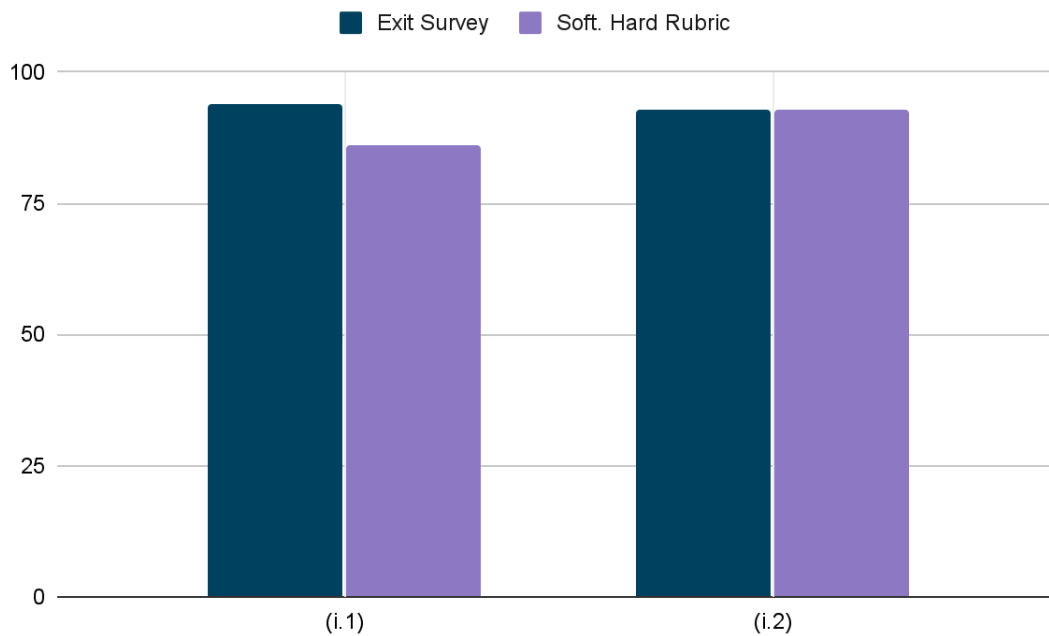
The document Criteria for Accrediting Computing Programs for those programs effective for review during the 2024-2025 Accreditation Cycle present on page 5, three (3) topics that must be included in the curriculum. These are:

1. Techniques, skills and tools necessary for computing practice.
2. Principles and practices of security and privacy in computing.
3. Local and global impacts of computing solutions on individuals, organizations, and society.

The instruments that we have already implemented have helped us to know the attainment of 1, 2 and 3. In this section we are going to present our findings.

### Topic 1: Techniques, skills and tools necessary for computing practice:

The following histogram summarizes the results obtained from the exit survey and a rubric.



These were performance indicators used in a previous cycle. We have measured them into this cycle as well. Therefore we use it to validate the coverage of the topic. The following PIs were used:

(i.1) Use hardware and software tools currently available

All the students that completed the exit survey gave this indicator a grade of A (an average of 94%). Around 86 % of the students used hardware and software tools currently available. This was obtained by looking at the results from the Rubric to Evaluate Software and Hardware Tools. Therefore the AAC concluded that the achievement level for this PI was met.

(i.2) Use current techniques and skills in the practice of the profession.

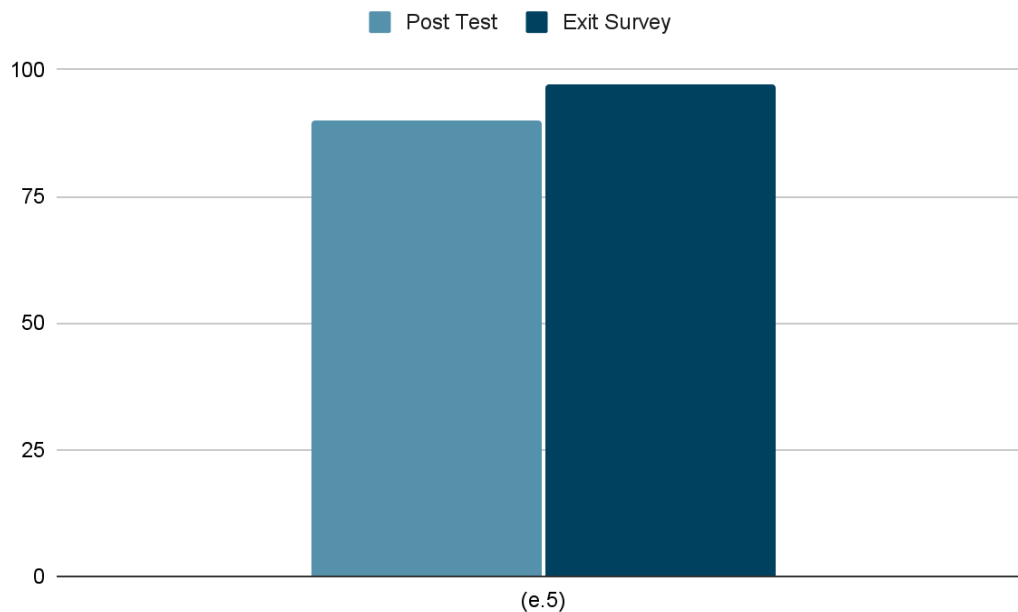
All the students that completed the exit survey gave this indicator a grade of A (an average of 90%). Around 93 % of the students used current techniques and skills during the courses. This was obtained by looking at the results from the Rubric to Evaluate Software and Hardware Tools. Therefore the AAC concluded that the achievement level for this PI was met.

## Conclusion

This topic was covered with excellence.

## Topic 2: Principles and practices of security and privacy in computing.

The following histogram summarizes the results obtained from the post-test and the exit survey.



This performance indicator was used in a previous cycle. We have measured it into this cycle as well. Therefore we use it to validate the coverage of the topic.

(e.5) Understand the vulnerabilities of a system to guarantee a high level of security of the data that needs to be secured.

On the Post-test 89% of the students answered the questions related to this PI correctly. All the students that completed the exit survey gave this indicator a grade of A (an average of 97%). Therefore the AAC concluded that the achievement level for this PI was met.

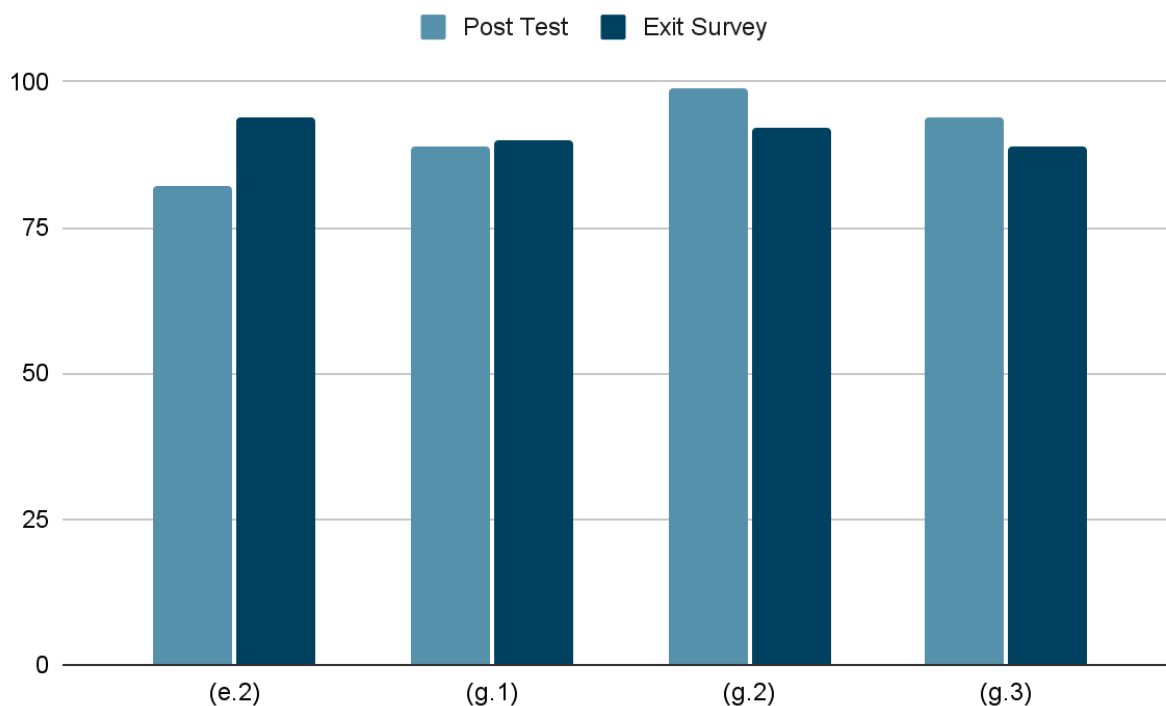
## Conclusion

This topic was covered with excellence.

## Topic 3: Principles and practices of security and privacy in computing.

The following histogram summarizes the results obtained from the post-test and the exit survey.





These were performance indicators used in a previous cycle. We have measured them into this cycle as well. Therefore we use it to validate the coverage of the topic. The following PIs were used:

(e.2) Evaluate the social impact of a given computing technology

On the post-test 82% of the students answered the questions related to this PI correctly. All the students that completed the exit survey gave this indicator a grade of A on average 95%. Therefore the AAC concluded that the achievement level for this PI was met.

(g.1) Understand computational or technological advances and their impact on individuals, organizations and society.

On the post-test 94% of the students answered the questions related to this PI correctly. All the students that completed the exit survey gave this indicator a grade of A on average 90%. Therefore the AAC concluded that the achievement level for this PI was met.

(g.2) Recognize the global and local impact of a given technology.

On the Post-test 99% of the students answered the questions related to this PI correctly. All the students that completed the exit survey gave this indicator a grade of A on average 93%. Therefore the AAC concluded that the achievement level for this PI was met.

(g.3) Be aware of the state of the art in computing technology.

On the posttest 95% of the students answered the questions related to this PI correctly. All the students that completed the exit survey gave this indicator a grade of B on average 92%. Therefore the AAC concluded that the achievement level for this PI was met.

## Conclusion

This topic was covered with excellence.