Unit assessment for Math 141 Plane Trigonometry

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Introduction	1
Department buy-in and outcome definition	1
Assessment research and design	1
Pilot assessment tools and processes	2
Administer specific assessment	3
Data analysis	3
Supporting evidence-based change	4
Program assessment update in discipline	4
Conclusion	4
Appendix	5



For choosing an optimum topic/concept to assess in this course, we opted for the Student Learning Outcome: "Solve trigonometric equations." The Math 141 assessment consists of Four components: solve a trigonometric equation in specific domain interval and in general, choose a correct solving process, and solve a trigonometric equation by continuing the solving process. The assessment includes three multiple choice and one open-ended math problems. The pilot for this assessment was administered during the Spring semester of 2021. Its original sample tallied 39 responses. After eliminating duplicates as well as removing invalid or missing ID responses from the pilot sample, we ended up with a data set of 29 unique student responses.

The analysis of this first pilot sample showed that students performed better than we expected in solving a trigonometric equation in general and chose a correct solving process; however, we also found that students had more difficulty with including all correct options in solving a trigonometric equation in a specific domain interval. The result also showed most students tried to answer the open-ended question, solve a trigonometric equation by continuing the solving process. The participation on this question is better than we expected.

For the Fall term of 2021, we are planning to invite more mathematics full-time faculty members to collaborate in finalizing our innovative assessment and administering it by the end of the semester. We would try to collect more unique student responses.

Department buy-in and outcome definition

Math 141-Plane Trigonometry is one of the two courses (Math 140-College Algebra; Math 141-Plane Trigonometry) which are the prerequisite for Math 207 Calculus I. At the end of Fall 2020, the Mathematics Department started a new assessment process for this course. Math faculty considered "Solve trigonometric equations" a particularly important SLO students need to master for further courses in Mathematics curriculum, especially in Calculus sequences. During this semester, we created and administered a pilot assessment addressing this SLO.

Assessment research and design

To follow the footprint for Math 140 assessment which we started from the scratch and created our own innovative pilot tool, we have decided to do the same process for Math 141. As a preliminary discussion among the math faculty, we devised a set of problems that best cover the full contents of the SLO while paying special attention to the most common mistakes that students make. We collected data from previously administered assignments in various courses, as related to this topic. It was interesting to find that there were a few

recurrent and common mistakes that the students typically made not only from Math 141 but also in Math 207/208-Calculus I/II in which trigonometric equations are involved in various parts of the course. We decided to address all these common errors in our assessment.

By midterm, the math faculty created and designed a short online survey on Google Forms containing six problems: find the period of two different trigonometric functions, solve trigonometric equations under different conditions, as well as solve trigonometric equations involving applying trigonometric identities. (see Appendix A).

As in our previous assessment, we have used Google Forms because it is browser independent and especially mobile friendly, which is a significant advantage for students. Another benefit in using Google form is the facility to export the responses into an Excel document that helps perform all appropriate analyses on collected data.

We created the pilot questions on Word documents first to make use of the Math editing tool available in that platform and not as efficiently offered in Google forms. In addition, the Google form interface did not allow for any math editing to properly display mathematical representation in the question itself. We responded to that setback by reiterating the equations in a correct mathematical format and including them as images in the answer options from which the student would select.

Pilot assessment tools and processes

Starting in week 9 of the semester, we invited all faculty, including our part time colleagues who are teaching Math 141, Math 207, Math 208, both remote learning and online formats to be part of this project. All were introduced to the project via e-mail and/or in one-on-one discussion (virtually) to emphasize the importance of their participation and encourage everyone to volunteer and urge their students to take the assessment survey. This pilot assessment was administered for the last 7 weeks of the spring 2021 semester including Spring Break. We have been heartened to have so far collected 29 unique responses in this period of time.

We are eager to get into the analysis phase of the data from this pilot and we are looking forward to creating an appropriate assessment for our students in the Fall 2021 semester. We may be able to include face-to-face format if we resume in-person learning for the fall semester for related courses(Math 140, Math 207, Math 208 and Math 209). The Mathematics Department is planning to examine patterns and determine if the students' results are influenced by the way of the delivery formats, specifically taught in-person, remote live or online. All this information will help us narrow down strategies to enhance our teaching, with the goal of improving our students' learning.



Administer specific assessment

Coming in Fall 2021 after the full scale of the assessment.

Data analysis

Initial findings from the pilot.

During the Spring 2021, we completed the pilot assessment. Students performed better than we expected in solving a trigonometric equation in general and choosing a correct solving process; however, we also found that students had more difficulty with including all correct solutions in solving a trigonometric equation in a specific domain interval. For question #2, solve a trigonometric equation in general, more than half of the students (17, 59%) chose the correct solution. For questions #3, chose a correct solving process, more than 60% of students (19, 66%) chose the correct solving process.

For questions #1, solving a trigonometric equation in a specific domain interval. Less than half of the students (12 individuals, 41%) chose both correct solutions. This was not too surprising since this topic is challenging, and students tend to only include the solution within the most common period.

The result also showed most students (24, 83%) tried to answer question #4, the open-ended question, solve a trigonometric equation by continuing the solving process. The participation rate on this question is surprisingly higher than we expected. Among the 24 responses, 3 responses included all corrected solutions with detailed solutions steps, 3 responses included all corrected solutions without showing any work, and 15 responses included partially correct solutions, and 3 responses were completely wrong.

Some other findings from the pilot.

• The population of the participants.

This assessment was sent to pilot groups of students from Math 141, Math 207, Math 208, Math 209. Among those 29 valid responses, 14 (48%) of them are from Math 141 and 15 (52%) are from Math 207.

• The device students were using to take this survey.

Four choices were listed including Computer (Desktop or Laptop), Tablet (iPad or Android tablet etc.), Cell Phone and Other. 26 (90%) of the students used Computer (Desktop or Laptop) and 3 (10%) of the students used Cell Phone.

• Feedback questions were asked to all participants, "Did you have any challenge or technique issue during the survey? Do you have any other suggestion(s) to help us improve the survey for the future students?"

23(79%) of students had no challenge, 1 (3%) student had internet/Wi-Fi issue, 1 (3%) student had challenge to write the solution steps for the open-ended question on his/her cell phone since some of the math symbols are not available in Cell phone keyboard, and 4 (14%) students indicated the open-ended question had not enough room for solution/formatting issues.

The detailed pilot results will be shared in the early Fall 2021 semester.

Supporting evidence-based change

Coming in Fall 2021 after the full scale of the assessment.

Program assessment update in discipline

The Math Department at Harold Washington College, piloted Math 140 College Algebra assessment in Spring 2019, administered the full scale of Math 140 College Algebra assessment in Fall 2019 and Spring 2020. The results were analyzed and shared in Fall 2020.

The Math Department at HWC decided to do the departmental Math 141 Plane Trigonometry assessment starting Spring 2021. We designed and piloted Math 141 Plane Trigonometry assessment in later Spring 2021 and planned to analyze the results from the pilot , update/modify the assessment if needed and do a full scale of the assessment in later Fall 2021.

Conclusion

Coming in Fall 2021 after the full scale of the assessment.



Appendix

Appendix A



Spring 2021 HWC Math 141 related topic(s) Survey

Introduction:

STOP: If you have already taken this survey this semester, please STOP! Only take it once! If your teacher is offering extra credit, simply tell them you already took it for another class, and they should still give you the extra credit. If you have not yet taken it, please proceed.

RAFFLE: There will be a raffle drawing for a \$10 Amazon gift card raffled for students who complete this survey.

Thank you SO MUCH for volunteering to participate in this survey. Your participation will help to inform curriculum development, pedagogical practices, course design, and policy decisions at Harold Washington College. Your participation is voluntary and your responses confidential. You can stop your participation at any time and whether you participate in the survey or not, it will have no impact on your grade. We will only analyze the data in the aggregate (the big picture), not individual responses. We ask for student ID number for demographic purposes only. Please have your 9 digit student ID handy.

This survey consists of Three multiple choice and One open-ended math problems. Please answer each item honestly and based on your own knowledge, without any help from other people or resources. We hope you will use your best effort to help us gather valid data, but you have the right to stop answering questions at any time.

Throughout the survey, remember to click the NEXT button to continue to each section, and SUBMIT at the end. Also remember to never click the browser's back or forward buttons, as this will mess up the survey.

If you have questions or concerns about this assessment process, please contact Ms. Lu, the assessment liaison at Math Department at <u>clu1@ccc.edu</u> or call 312-553-5937.

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Please enter your 9 digit student ID. Providing this information allows us to reduce the time of this survey and improve its reliability. Again, this information is confidential and not linked to individual student performance.

What is your student ID

Note: Enter your 9 digit student ID (no dashes). This information is anonymous and is not linked to individual student performance in class.

Your answer

Indicate your course number /Which math course you are enrolled for this semester

Math 141 (Plane Trigonometry)

Math 207 (Calculus & Analytic Geometry I)

Math 208 (Calculus & Analytic Geometry II)

Math 209 (Calculus & Analytic Geometry III)

) Other:

What device	e are you using t	o take this survey?		
	outer (Desktop	or Laptop)		
🔿 Table	t (iPad or Andr	oid tablet etc.)		
Cell F	hone			
Other	:			

Section A. Solve the equations.
1.
Solve the equation $sin(x) = 1$ over $[0, 4\pi]$. Please choose all the possible solutions.
1/sin
0
π/2
π
(3π)/2
2π
(5π)/2
3π
(7π)/2
4π

2.
Solve $\tan(x) = 1$ for all possible values of x.
Ο π/4
π/4, (3π)/4, (5π)/4, (7π)/4
Ο π/4, (5π)/4
\bigcap $\pi/4 + (k\pi)/4$, where k is an interger
\bigcirc $\pi/4 + k\pi$, where k is an interger
\bigcap $\pi/4 + 2k\pi$, where k is an integer
Back Next





4.

Solve $\sin(x) + \cos(x) = 1$ on the interval $[0,2\pi]$.

Please show your work to continue the following solving process and find the solution(s).

Step1:

 $[\sin(x) + \cos(x)]^2 = 1^2$

 $sin^{2}(x) + 2sin(x)cos(x) + cos^{2}(x) = 1$

... ...

Please continue the solving process to find the solution(s), show your work by typing in the following answer box.

Note:

- While you are typing your answer, you can hit "enter" key on your keyboard to move to the next line to continue typing.
- You can use symbol "^" to type an exponent. For example, you can type [sin(x)]² to represent sin²(x).
- 3. Please use "pi" to represent the symbol " π " if you are not able to type the symbol " π ". For example, you can type "pi/2" to represent " $\frac{\pi}{2}$ ".
- 4. You can use comma "," to separate your answer(s) if you have more than one solution.



suggestion(s) to help us improving the survey for the future students? Your answer
'our answer
Back