OVERCOMING THE CHALLENGES OF E-ASSESSMENT IN GEOMETRY ADVANCED COURSES

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OUTLINE

1. Introduction
2. The Context
3. Examples, discussions and suggestions

INTRODUCTION

- A geometry undergraduate course, offered online;
- Online Assessment: Blackboard;
- Respondus-Lock-down browser with monitor;
- Outcomes Based Education, Assessing CLOs;

CHALLENGES: NOT COMPUTER-FRIENDLY

Unlike other branches of mathematics such as calculus and linear algebra, geometry is not computational (algorithmic).

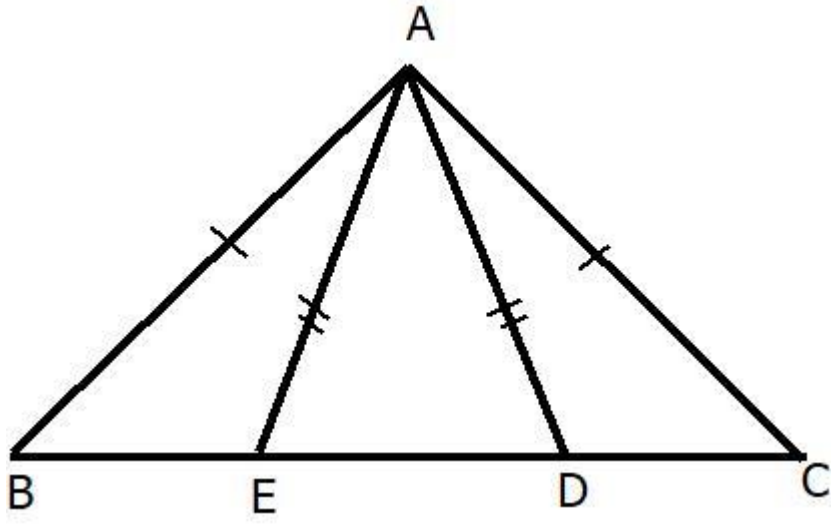
Algebra: Solve $3x + 9 = 10$.

Solution: $3x + 9 = 10 \rightarrow\ 3x + 9 - 9 = 10 - 9 \rightarrow 3x = 1 \rightarrow x = \frac{1}{3}$.

Geometry: Show that *CD=BE*.

How?

"*Rather than the memorization of simple algorithms to solve equations by rote, it demands true insight into the subject, clever ideas for applying theorems in special situations, an ability to generalize from known facts …*" B. Artmann 2020.



CHALLENGES: VAN HIELE MODEL 4 (RIGOR)

The VH Model divides geometry thinking stages attained by geometry learners into five different levels and decribes how students progress from one level to the other.

- Level 0 (Basic Level): Visualization
- Level 1: Analysis
- Level 2: Informal Deduction
- Level 3: Deduction
- Level 4: Rigor (Synthesis, critical thinking, writing complete proofs, ….)

CHALLENGE: SUCH AN OUTCOME

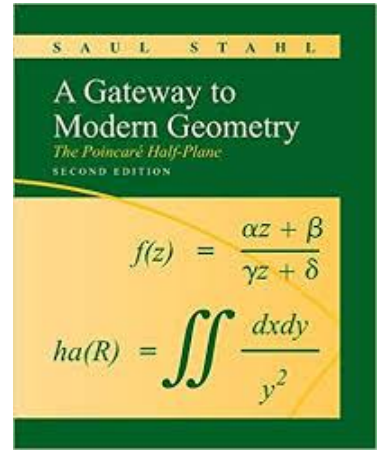
How can we E-assess such an outcome?

CLO 3: Construct scientifically geometric figures with a ruler and a compass.

A multi-step task which require listing the construction steps, execute them properly and writings proofs.

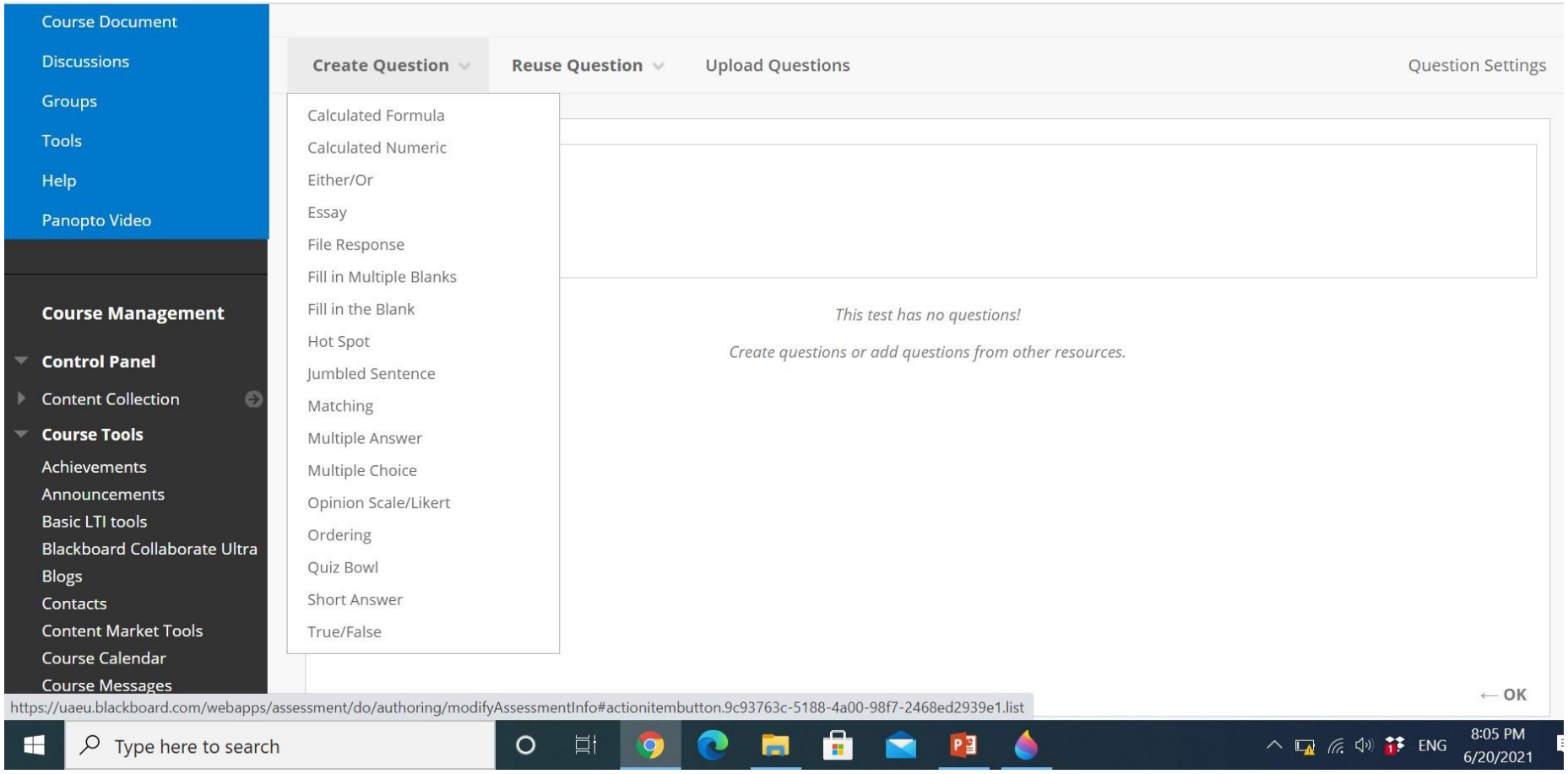
2. THE CONTEXT

- Foundation of Geometry Course [3CH];
- Topics. Euclidean and non-Euclidean geometries, spherical geometry, hyperbolic geometry; Poincare model, Klein-Beltrami model, hyperbolic triangle, hyperbolic area, and Gauss-Bonnet theorem; transformations, symmetry, Euclidean rigid motions, inversions, and hyperbolic rigid motions.



- It is offered for students in Science, Engineering and Education (pre-service teachers);

BLACK BOARD


Course Document
Discussions
Groups
Tools
Help
Panopto Video
Course Management
Control Panel
Content Collection
Course Tools
Achievements
Announcements
Basic LTI tools
Blackboard Collaborate Ultra
Blogs
Contacts
Content Market Tools
Course Calendar
Course Messages
Create Question
Reuse Question
Upload Questions
Question Settings
Calculated Formula
Calculated Numeric
Either/Or
Essay
File Response
Fill in Multiple Blanks
Fill in the Blank
Hot Spot
Jumbled Sentence
Matching
Multiple Answer
Multiple Choice
Opinion Scale/Likert
Ordering
Quiz Bowl
Short Answer
True/False
This test has no questions!
Create questions or add questions from other resources.
← OK
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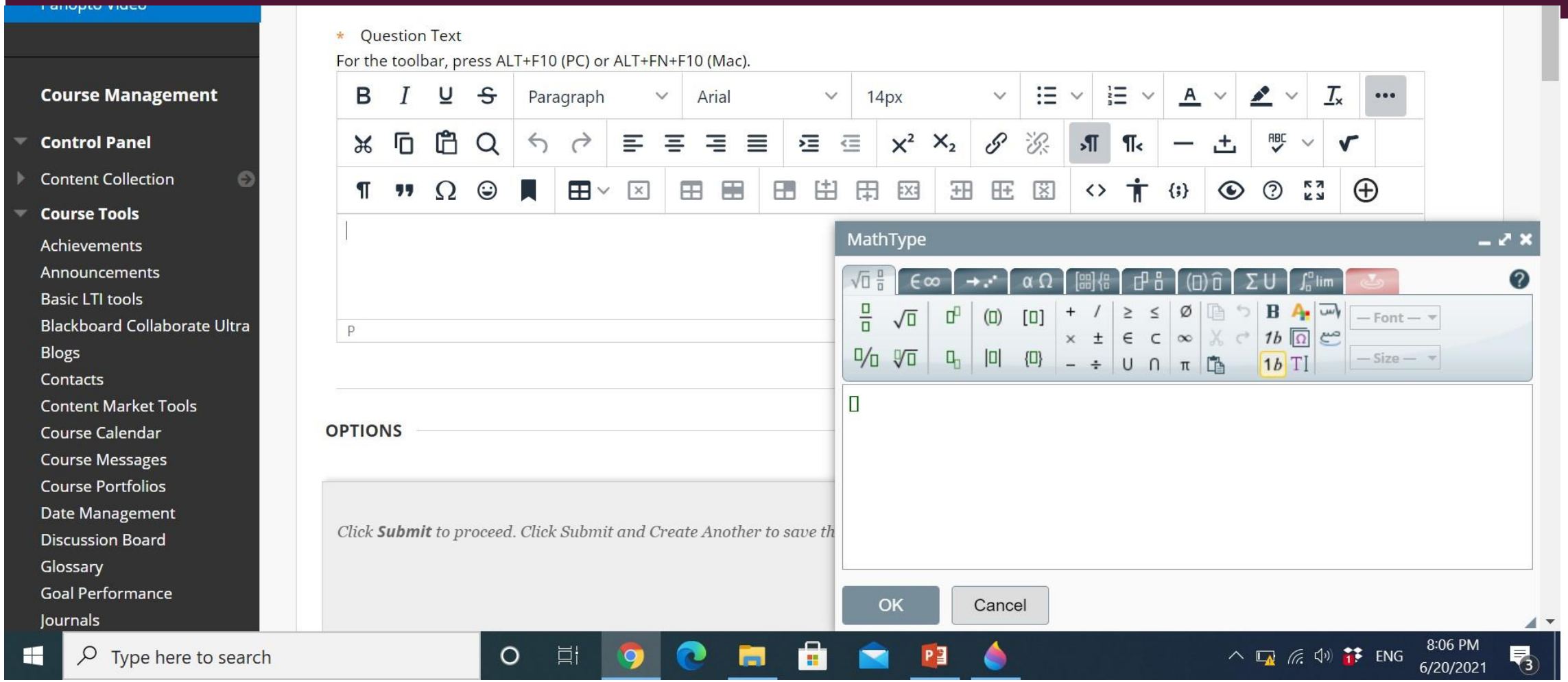
THE EDITOR (LATEX COMPATIBLE)



CLOS ASSESSMENT

MATH 260, Foundation of Geometry, Spring 2020

Final Exam (ONLINE)

Date: 16/5/2020, 8:30-10:30 AM

Student Name: _____

Student ID: _____

Attendance Number: _____

	PLO2	PLO1	PLO5	PLO2	
Course Outcome	CLO1	CLO2	CLO5	CLO4	Total
Question	Q1-11	Q12-16	Q17-18	Q19	
Maximum Score	15	10	11	4	40
Student's Score					

EXAMPLES

Question 3 — **2 points** — Save Answer

The hyperbolic center the Euclidean circle of center (0,4) and radius 2 is the point:

- ○ (0,4)
- ○ $(0, \sqrt{12})$
- ○ (0,ln(8))
- ○ (0,12)
- ○ None of the above.

Question 15 — **2 points** — Save Answer

The inversion $I_{O,1}$ where $O=(0,0)$ transforms the circle q of center $(5,5)$ and radius 1 into

- ○ A line through O.
- ○ A line not through O.
- ○ A circle not through O.
- ○ A circle through O.

ON PAPER EXAM

Question 1. [5 marks] Let q be a circle and P a point outside q.

(a) Explain how to construct, using the ruler and compass, a tangent line to q through P.

(b) Explain how to construct, using the ruler and compass, the point P' symmetrical to point P with respect to q.

Question 2. [2 marks] Is there an Euclidean rigid motion which transforms $P = (2, 2)$ into $P' = (4, 4)$ and $Q = (1, 3)$ into $Q' = (2, 5)$. Justify your answer.

Question 3. [4 marks] Let q be the circle of center $(2, 0)$ and radius 1. Find the image of q by the inversion $I_{O,4}$, where $O = (0, 0)$.

Question 4. [6 marks] For each of the following statements say whether it is true or false.

Question 5. [8 marks] **(a)** Find the hyperbolic length of the geodesic joining $P = (2, 3)$ and $Q = (2, 6)$.

(b) Find the hyperbolic length of the segment of line $y = x + 1$ joining $A = (1, 2)$ and $Q = (3, 4)$.

(c) Find the hyperbolic length of the bowed geodesic joining $P = (6, 3)$ and $Q = (5, 4)$.

Question 6. [6 marks] **(a)** Find the hyperbolic area of the rectangle whose vertices are $(0, 1)$, $(0, 5)$, $(1, 1)$ and $(1, 5)$.

(b) Find the hyperbolic area of the Euclidean triangle whose vertices are $A = (1, 2)$, $B = (3, 2)$ and $C = (3, 4)$.

(c) Find a hyperbolic rigid motion which transforms $P = (2, 3)$ into $P' = (5, 6)$.

Question 7. [6 marks] Find the hyperbolic area of the hyperbolic triangle whose vertices are $A = (0, 2)$, $B = (-4, 2)$ and $C = (6, 2)$.

Question 8. [3 marks] Find the hyperbolic (vertical) line m such that the angle from m to the hyperbolic line joining $A = (0, 2)$ and $B = (4, 2)$ is $\frac{\pi}{3}$? Justify your answer.

SUGGESTIONS

- Blended assessment using both on-paper and online (computer based) questions;
- The implementation of these blended assessment is not practical for large sections;
- For such CLO. Construct scientifically geometric figures with a ruler and a compass;
- We suggest to use Project-based learning and assess students' reports and oral presentations;

THE PROJECTS

- Material related to outcome 3 will be self-learned by students while working on a project.
- The Instructor gives an introduction to the subject in class, then explains what is required from students.
- Sample of Project: construction using straight-edge and compass
  1. Construct basic geometric figures; [Knowledge]
  2. A more challenging construction; [Solving]
  3. A creative design suggested by students; [Innovation]
  4. Explain all steps and justify all claims; [Logic; critical thinking]
- Instructions and grading rubrics are distributed to students;