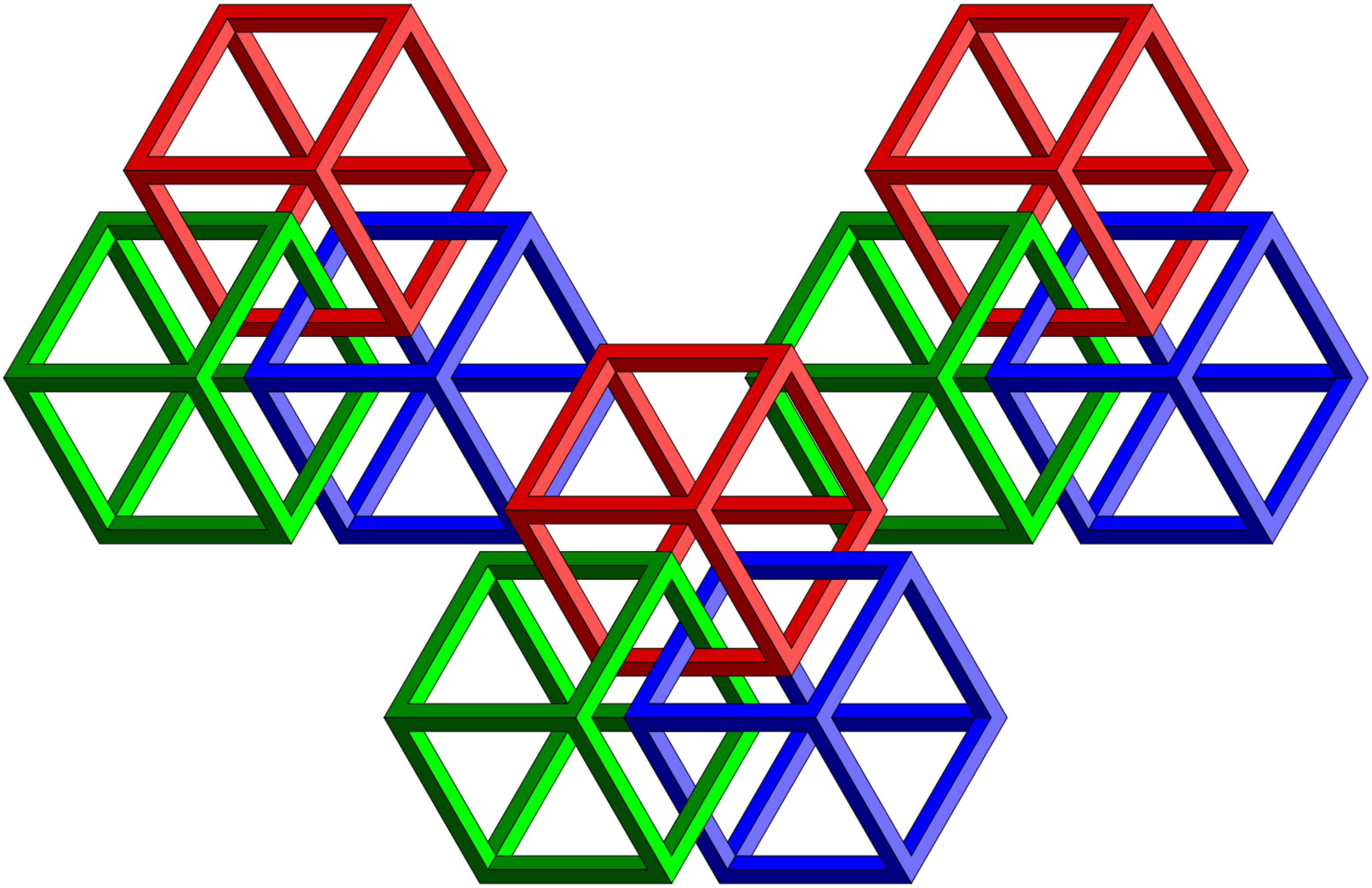

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2D/3D adventures: A blended geometry unit

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IT 570 Instructional Systems Design – Fall 2013
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Executive summary

The problem/challenge

The purpose of the unit of instruction that follows is to teach students how to solve real-life and mathematical problems involving perimeter, circumference, area, surface area, and volume. The target audience for the instructional unit is primarily high school juniors who have an IEP (Individualized Education Program). By the end of the unit of instruction, students will be able to name polygons and solid 3D figures, and find perimeter, circumference, area, surface area, and volume of polygons and solids.

The proposed solution

Delivery of instruction will be blended with activities occurring synchronously and asynchronously. Direct instruction will be take place at home and collaborative work such as peer tutoring, a group project, Think-Pair-Shares, and a relay race activity will occur at school. This approach will allow additional time on parts of the proposed instruction that is anticipated to better prepare these students to pass the course. Formative and summative assessments will be used to ensure students are mastering daily lesson objectives.

Technology used

Course documents will be stored in and accessible from the Learning Management System which students will access using their school-issued laptop. The classroom is equipped with a Smartboard, projector, document camera, and three additional student desktop computers. Additionally, sites like KhanAcademy.org, ShowMe.com, Quizlet.com, Socrative.com, and our online textbook (www.pearsonsuccessnet.com) will be used.

Implementation and evaluation plan

The implementation of the unit of instruction will entail preparations for the face-to-face portions of the unit of instruction and the online synchronous and asynchronous portions of instruction. The TPaCK (technological, pedagogical, and content knowledge) coach and computer technician will be consulted regarding hardware and software issues. The evaluation strategy for the unit of instruction will follow Kirkpatrick's Model, and the results of the different levels of evaluation will be presented to various stakeholders – students, faculty, parents, math department head and instructional coach, special education supervisor, grade-level principal, and principal.

Introduction

Project description and background

In order to obtain a high school diploma in Tennessee, students must earn 22 credits in science, social studies, English, math, fine arts, P.E./health and wellness, foreign language, personal finance, and an elective focus area. Requirements for special education students are no different; however, in the area of math, students with disabilities may achieve credit through increased instructional time, appropriate methodologies, accommodations, and other differentiated instruction as determined by the Individualized Education Program (IEP) team (Fisher & Townsend, 2010). All high school students are required to take four credits of math. Most special education students take Algebra I their freshman and sophomore years and take Geometry their junior and senior years. This slower pace allows students to spend about four times the amount of time that regular education students spend on high school math standards. The additional time-on-task afforded by parts of the proposed instruction that will be online is anticipated to better prepare special education students to pass the course. In addition, the high school where the unit of instruction will be implemented has recently become a 1:1 laptop school, where every student and teacher has their own MacBook Pro. The school uses Canvas, a learning management system, to store and provide access to course offerings.

Statement of need

The Knox County Schools curriculum and instruction department has set forth the curriculum framework for geometry teachers and students. One of the Common Core State Standards for that curriculum is solving real-life and mathematical problems involving angle measure, area, surface area, and volume (7.G.B). The basis of the need for my proposed unit of instruction is that the goal and objectives outlined below will be tested on the county's end-of-course exam. Students' grade on that exam will be worth 25 percent of their final grade, and they will need to pass the geometry with a D or higher in order to get the math credit needed to graduate high school. Students need extra help to pass the course. By providing access to materials online, the instructor will be able to ensure students get additional practice that they don't have enough time for during the face-to-face class.

Learner analysis

The target audience for this instruction is special education high school juniors with specific learning disabilities in reading comprehension, written expression, and math, and/or with autism, functional delays, and emotional disabilities. In addition, special education high school seniors who failed Geometry A and sophomores who struggled taking the semester-long Algebra I may also be included in the target audience. Because the course is offered at a slower pace, the target learners are able to spend about four times the amount of time that regular education students spend on the course. Also, the targeted students have an IEP, which includes accommodations in the classroom and on the end-of-course exam. Common accommodations include extra time for assignments and tests, small group setting, oral and written directions, use of calculator, and abbreviated and modified assignments.

Academic motivation of the learners will need to be addressed. Most students have not had much success with math. They struggle with fluency and conceptual understanding of topics. Although the subject of instruction was presented in middle school math class, many students' background knowledge may be hazy as their long-term memory is often deficient. This means the topic of instruction will be presented as new material. The slower pace of instruction will allow for students to experience success of objective mastery, and, in turn, increase their motivation to learn new material.

Performance and learning contexts

The performance context for this instruction is two-fold. Students will use the knowledge and skills gained through this instruction on the end-of-course exam at the end of their senior year of high school, and in real-life situations involving perimeter, area, surface area, and volume. For example, students may have to one day determine how much paint to buy or if a particular piece of furniture will fit in their home's living room.

The learning context will take place in a public high school classroom equipped with a Smartboard, document camera, projector, and laptops for the instructor and each student. The school follows a block schedule where classes are 80 minutes. The instructor will primarily take an Instructivist approach but also incorporate Social Constructivist pedagogy. Learners will engage in a variety of learning processes and activities based on Bloom's Taxonomy. Students will work independently as well as collaborate with partners and in small groups synchronously and asynchronously. For a detailed description of how the instruction will proceed, please see Appendix A. Learning will be assessed formatively on a daily basis using bell work, exit tickets, and quizzes.

The more there is alignment between the performance and learning contexts the better the transfer of learning (Larson & Lockee, 2014, p. 63). While on a practical performance level students will use their newfound knowledge in real-life, the more immediate performance context will be the county end-of-course exam. This means there will have to be a balance of providing authentic situations or tasks for the learner along with exam-type questions so that the learner is prepared for both types of situations where they will ultimately use the knowledge and skills obtained from the instruction.

Overall instructional goal

Students will work in a blended learning environment to master the Common Core State Standard (7.G.B) of solving real-life and mathematical problems involving angle measure, area, surface area, and volume. In order to reach that goal, students will need to master a series of daily objectives. Students will be able to

- Name polygons
- Find perimeter, circumference, and area of polygons
- Identify solid figures in 3D
- Find surface area and volume of solids

(*Please note: The topic of angle measure will be addressed in a different module, and the addition of finding perimeter and circumference has been added by Knox County Schools curriculum and instruction department.*) Students will receive instruction on the objectives both face-to-face and online and will demonstrate mastery of these objectives by correctly completing synchronous and asynchronous activities.

Instructional treatment

The theoretical basis for the instructional design will include assumptions about learning and different pedagogical approaches while explaining clear links to the learning outcomes those approaches will support. Assumptions will be mainly cognitivist but will include some constructivist elements. A crucial cognitivist assumption is the importance of linking old knowledge to new knowledge (Larson & Lockee, 2014, p. 77). Moreover, the constructivist approach emphasizes "authentic real-world experiences and reflection about those experiences" (Larson & Lockee, 2014, p. 77). As for the pedagogical approach, the instruction will be primarily Instructivist in nature for the foundational skills required. There will also be room for a Constructivist approach where learners will be involved in activities that mimic real-world situations once those basic skills and knowledge have been mastered.

In sum, I am taking this pedagogical approach and including these teaching and learning strategies to prepare learners to master these assessments to prepare them to become competent in solving real-life and mathematical problems involving perimeter, circumference, area, surface area, and volume. I believe learning takes place when information is organized from simple to complex and accompanied by practice and feedback from the instructor while at the same time acknowledging the importance of collaborative groups so that learners can experience different perspectives and build knowledge together (Larson & Lockee, 2014, p. 83-85).

Content analysis

The Knox County Schools Curriculum and Instruction Department determined the instructional content for the unit of instruction. High school mathematics courses follow a curriculum framework based on the Common Core State Standards (CCSS). Geometry contains five "modules" of instruction. The standard being covered in this design project is under the first module called "Preparing for Geometry." Topics in the first module include a foundational review of skills that have been taught in previous math courses, such as Algebra I and middle school math classes, and will be used in upcoming geometry modules. Modules are sequenced in order but standards within modules may be adjusted at the instructor's discretion. The standard being taught in this unit of instruction comes near the end of the first module with previous standards' skills serving as the foundation for the next. For example, at this point in the curriculum, students know how to evaluate and solve algebraic expressions and equations.

The action map in Appendix B provides a thorough content analysis that illustrates the terminal goal, supporting objectives and knowledge, and relationships between those elements. The table in Appendix C includes learning outcomes, strategies, and assessments, and how they are aligned.

Instructional technologies

A variety of instructional technology will be used during the unit of instruction. The delivery of instruction will be blended with activities occurring synchronously and asynchronously. Students have their own school-issued MacBook Pro. The course documents will be stored in and accessible from the Canvas Learning Management System.

Instructional strategy	Technology selection
Motivate learners to engage in learning processes	Smartboard used to display examples of polygons

	YouTube video clip of real-life situation of someone using knowledge of area and perimeter (possibly from HGTV show)
Present content and communicate expectations	Narrated PowerPoint presentations provide variety of examples accessible through LMS Lecture via screencast (KhanAcademy.org) and online tutorials (ShowMe.com) accessible through LMS
Organize content to aid mental processing	Graphic organizer (Word document) for notes, visuals – pictures and real-life examples accessible through LMS Online flashcards (Quizlet.com) linked to from LMS
Scaffold and guide, provide practice and feedback, differentiate and transfer	Chunked learning - Lecture via screencast (KhanAcademy.org) and online tutorials (ShowMe.com) accessible through LMS Drill and practice module – Socrative.com quizzes and space races Guided and independent practice – online textbook at Pearsonsuccessnet.com Prompt feedback on performance – Canvas LMS multiple choice quizzes
Promote cooperation and collaboration	Group project – collaborate online synchronously and asynchronously via Canvas LMS collaboration tool and discussion board

Implementation and evaluation strategies

The implementation of the unit of instruction will be relatively straightforward. Preparations for the face-to-face portions of the unit of instruction will include daily lesson plans and reproduction of learner materials. For the online synchronous and asynchronous portions of instruction, guidelines for interactions and discussions will be established. The Canvas LMS navigation will be arranged in a user-friendly way with course features following the same format as previous units of instruction. Any new LMS features introduced will be explained thoroughly. The school's TPaCK (technological, pedagogical, and content knowledge) coach and computer technician will be consulted regarding issues that arise related to hardware and software following school-wide procedures, e.g., sending students for help during help desk hours or submitting teacher technology issues through the online tracking system, SchoolDude. If students and teachers have issues with the LMS after school hours, they can consult the Canvas Help Center (https://help.instructure.com/home) at anytime.

The evaluation strategy for the unit of instruction will follow Kirkpatrick's Model: Level I Learner Reaction, Level II Learning, Level III Behavior, and Level IV Results (Larson & Lockee, 2014, p. 11). The results of the different levels of evaluation will be presented to various stakeholders – students, teachers, parents, math department head and instructional coach, special education supervisor, grade-level principal, and principal.

Evaluation Strategy	
Level I Learner Reaction	**Key question:** Did the learners enjoy the unit of instruction and find it relevant? **Formative**: Exit tickets **Summative**: End-of-semester course evaluations
Level II Learning	**Key question:** Did the learners learn what they were supposed to learn? **Formative**: Bell work, daily quizzes **Summative**: Unit test, end-of-course exam
Level III Behavior	**Key question:** How did unit of instruction affect long-term learner performance? **Formative/Summative**: Measuring this level may prove to be difficult since "it is typically measured several months or more after the instruction" (Larson & Lockee, 2014, p. 38). Geometry is the final high school math course these students will take. It might be possible to contact a sampling of students after graduation and ask them to self-report how they did on post-secondary math placement tests and their ability to apply learning in real-life situations.
Level IV Results	**Key question:** Did the unit of instruction positively impact students' projected growth rate and help close the achievement gap for special education students? **Formative**: Benchmark test given at end of junior year **Summative**: End-of-course exam data for individual and special education sub-group

References

Fisher, J.E., & Townsend B. (2010) *High school graduation requirements: Implementation of the new high school policy for students with disabilities* [PowerPoint slides]. Retrieved from www.state.tn.us/education/speced/doc/3210gradrequirements.ppt

Larson, M.B., & Lockee, B.B. (2014) *Streamlined ID: A practical guide to instructional design*. New York: Routledge.

Appendix A – Instruction progression

1. Identify names of polygons
    At home:
        Students will …
        (a) view narrated PowerPoint presentations that provide a variety of examples
        (b) take notes using a graphic organizer
        (c) view online flashcards and visuals – pictures and real-life examples
        (d) complete drill and practice module, and guided and independent practice

2. Match name to shape of polygons
    At school:
        Students will …
        complete a matching activity game/competition.

3. Calculate perimeter of polygons
    At home:
        Students will …
        (a) watch lectures via screencast
        (b) take notes using a graphic organizer
        (c) view online flashcards and visuals – pictures and real-life examples
        (d) complete drill and practice module
        (e) complete guided and independent practice

    At school:
        Students will …
        (a) complete online tutorials, authentic problem scenarios, and variety of examples
        (b) participate in peer tutoring, a group project, Think-Pair-Share, and scavenger hunts

4. Calculate circumference of polygons
    At home:
        Students will …
        (a) watch lectures via screencast
        (b) take notes using a graphic organizer
        (c) view online flashcards and visuals – pictures and real-life examples
        (d) complete drill and practice module
        (e) complete guided and independent practice

    At school:
        Students will …
        (a) complete online tutorials, authentic problem scenarios, and variety of examples
        (b) participate in peer tutoring, a group project, Think-Pair-Share, and scavenger hunts

5. Calculate area of polygons
    At home:
        Students will …
        (a) watch lectures via screencast
        (b) take notes using a graphic organizer

(c) view online flashcards and visuals – pictures and real-life examples
(d) complete drill and practice module
(e) complete guided and independent practice

At school:
Students will …
(a) complete online tutorials, authentic problem scenarios, and variety of examples
(b) participate in peer tutoring, a group project, Think-Pair-Share, and scavenger hunts

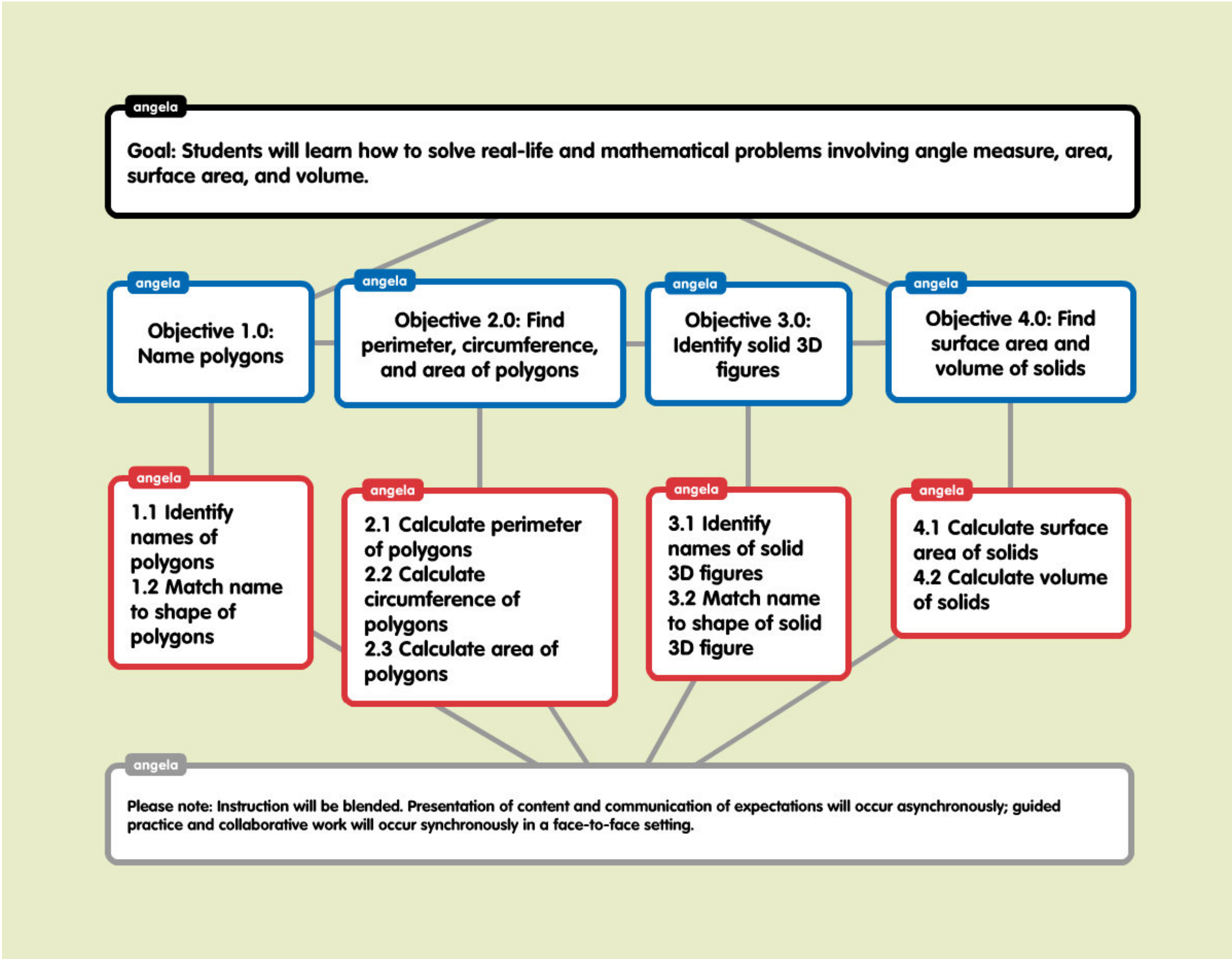
6. Identify names of solid 3D figures
At home:
Students will …
(a) view narrated PowerPoint presentations that provide a variety of examples
(b) take notes using a graphic organizer
(c) view online flashcards and visuals – pictures and real-life examples
(d) complete drill and practice module, and guided and independent practice

7. Match name to shape of solid 3D figure
At school:
Students will …
complete a matching activity game/competition and walk-about activity.

8. Calculate surface area of solids
At home:
Students will …
(a) watch lectures via screencast
(b) take notes using a graphic organizer
(c) view online flashcards and visuals – pictures and real-life examples
(d) complete drill and practice module, and guided and independent practice.
At school:
Students will …
(a) complete online tutorials, authentic problem scenarios, and variety of examples
(b) participate in peer tutoring, a group project, Think-Pair-Share, and relay race

9. Calculate volume of solids
At home:
Students will …
(a) watch lectures via screencast
(b) take notes using a graphic organizer
(c) view online flashcards and visuals – pictures and real-life examples
(d) complete drill and practice module, and guided and independent practice
At school:
Students will …
(a) complete online tutorials, authentic problem scenarios, and variety of examples
(b) participate in peer tutoring, a group project, Think-Pair-Share, and relay race

Appendix B – Content Analysis



Appendix C – Aligned Outcomes, Assessments & Strategies

Terminal goal: ***Students will be able to solve real-life and mathematical problems involving perimeter, circumference, area, surface area, and volume.***		
Learning Outcomes	**Assessments**	**Instructional Strategies**
Objective 1.0: Name polygons **1.1** Identify names of polygons **1.2** Match name to shape of polygons	**Formative:** Bell work, exit tickets, quizzes: provided a word bank, the student will be able to identify polygons. **Summative:** On a multiple-choice test with three answers to choose from, the student will be able to choose the name of the given polygon.	**Motivate learners to engage in learning processes:** Keller's ARCS motivation strategies (for example, to build learner confidence, realistic goals will be set, i.e., a handful of polygons to memorize at one time) **Present content and communicate expectations asynchronously:** Narrated PowerPoint presentations that provide a variety of examples **Organize content to aid mental processing:** Graphic organizer for notes, online flashcards, visuals – pictures and real-life examples **Scaffold and guide, provide practice and feedback, differentiate and transfer:** Chunked learning (not all polygons in one day), drill and practice module, guided and independent practice, prompt feedback on performance **Promote cooperation and collaboration synchronously in a face-to-face setting:** Teambuilding (matching activity game/competition)
Objective 2.0: Find perimeter, circumference, and area of polygons **2.1** Calculate perimeter of polygons **2.2** Calculate circumference of polygons **2.3** Calculate area of polygons	**Formative:** Bell work, exit tickets, quizzes: using class notes and examples, the student will be able to calculate perimeter, circumference, and area of polygons. **Summative:** On a test with a formula sheet, the student will be able to calculate perimeter, circumference, and area of polygons. **Knox County Schools Tasks:** Zoo	**Motivate learners to engage in learning processes:** Keller's ARCS motivation strategies (for example, to promote relevance, future usefulness of skill will be explored) **Present content and communicate expectations asynchronously:** Lecture via screencast, online tutorials, authentic problem scenarios, variety of examples, and peer

	Enclosure, Geometry House Plans	tutoring (synchronously) **Organize content to aid mental processing:** Graphic organizer for notes, online flashcards, visuals – pictures and real-life examples **Scaffold and guide, provide practice and feedback, differentiate and transfer:** Chunked learning (not all topics/formulas in one day), drill and practice, guided and independent practice, prompt feedback on performance **Promote cooperation and collaboration synchronously in a face-to-face setting:** Group project, Think-Pair-Share, scavenger hunt
Objective 3.0: Identify solid 3D figures **3.1** Identify names of solid 3D figures **3.2** Match name to shape of solid 3D figure	**Formative:** Bell work, exit tickets, quizzes: provided a word bank, the student will be able to identify solid 3D figures. **Summative:** On a multiple-choice test with three answers to choose from, the student will be able to choose the name of the given solid 3D figure.	**Motivate learners to engage in learning processes:** Keller's ARCS motivation strategies (for example, to build learner confidence, realistic goals will be set, i.e., a handful of solid 3D figures to memorize at one time) **Present content and communicate expectations asynchronously:** Narrated PowerPoint presentations that provide a variety of examples **Organize content to aid mental processing:** Graphic organizer for notes, online flashcards, visuals – pictures and real-life examples **Scaffold and guide, provide practice and feedback, differentiate and transfer:** Chunked learning (not all solid 3D figures in one day), drill and practice, guided and independent practice, prompt feedback on performance **Promote cooperation and collaboration synchronously in a face-to-face setting:** Teambuilding (matching activity game/competition, walk-about activity)

Objective 4.0: Find surface area and volume of solids **4.1** Calculate surface area of solids **4.2** Calculate volume of solids	**Formative:** Bell work, exit tickets, quizzes: using class notes and examples, the student will be able to calculate surface area and volume of solids. **Summative:** On a test with a formula sheet, the student will be able to calculate surface area and volume of solids.	**Motivate learners to engage in learning processes:** Keller's ARCS motivation strategies (for example, to promote relevance, future usefulness of skill will be explored) **Present content and communicate expectations asynchronously:** Lecture via screencast, online tutorials, authentic problem scenarios, variety of examples, and peer tutoring **Organize content to aid mental processing:** Graphic organizer for notes, online flashcards, visuals – pictures and real-life examples **Scaffold and guide, provide practice and feedback, differentiate and transfer:** Chunked learning (not all topics/formulas in one day), drill and practice, guided and independent practice, prompt feedback on performance **Promote cooperation and collaboration synchronously in a face-to-face setting:** Group project, Think-Pair-Share, relay race

Appendix D – Reflection on review and revision process

The iterative nature of the design process is, at the same time, comforting and disconcerting to me. I am a list maker, and I get a great deal of satisfaction from making to-do lists and checking things off to indicate that I am done with a particular item. That process makes me feel like I have accomplished something. I take comfort in that feeling. This semester's instructional design project has given me that feeling; I have been able to cross something off my list when I complete an assignment.

But, at the same time, I have also felt unsettled in the process because of the iterative nature of the project. I am not really done with designing the plan until the final due date. And so that is how it is in real life – essentially you are never done with a design plan because there is usually the opportunity to adjust and revise your instructional design plan, which can also be comforting in that you don't have to get it 100 percent right the first time. You can always change they way things are done based on the feedback you receive from your stakeholders.

Throughout the design process I received feedback from the instructor and my peers. Each time the instructor provided feedback, I revised my work. I found the detailed comments especially helpful and adjusted my plan accordingly. I made revisions to my plan based on all of the feedback I received from the instructor. The feedback from my peer group as a result of the pin-up critique and during breakout room sessions was encouraging. My group members were supportive of my efforts and had many nice compliments for my work. My only concern about my peers' feedback is that I thought they might have been a little too nice because much of their feedback was positive. They were definitely my cheerleaders.