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Abstract

As online and hybrid classes have become increasingly more prevalent in higher education, the flipped classroom structure has emerged as a viable, evidence-based, option for healthcare programs. In a flipped classroom, students view pre-recorded video lectures and complete reading assignments before class, and synchronous class time can then be used for active learning activities. Class sessions offer opportunities for group work, review of complex content, and access to instructor assistance with assignments. To effectively implement a flipped classroom approach, students must prepare prior to class time. One method for encouraging student accountability is to assign preparatory homework. This experimental study compared two types of accountability homework on measures of achievement, satisfaction, ease of use, and perceived learning from two types of assignments: concept maps or question-and-answer homework. Study participants included 46 first year occupational therapy students attending an online foundational occupational therapy course. Treatment included weekly completion of either a concept map or a set of three question-and-answer homework assignments over a period of three weeks. Findings suggested that accountability homework assignments of either type were helpful in promoting achievement. Results further revealed that satisfaction and perceived learning were greater in the concept map group as compared to the question-and-answer group. It is recommended that occupational therapy and other allied health instructors use accountability homework to reinforce student learning in the flipped classroom. The use of concept map assignments in particular has the potential to improve schema acquisition, critical thinking, and deep learning, which in turn can support educational success.

Keywords

Flipped classroom, concept map, online education, schema acquisition

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ABSTRACT

As online and hybrid classes have become increasingly more prevalent in higher education, the flipped classroom structure has emerged as a viable, evidence-based, option for healthcare programs. In a flipped classroom, students view pre-recorded video lectures and complete reading assignments before class, and synchronous class time can then be used for active learning activities. Class sessions offer opportunities for group work, review of complex content, and access to instructor assistance with assignments. To effectively implement a flipped classroom approach, students must prepare prior to class time. One method for encouraging student accountability is to assign preparatory homework. This experimental study compared two types of accountability homework on measures of achievement, satisfaction, ease of use, and perceived learning from two types of assignments: concept maps or question-and-answer homework. Study participants included 46 first year occupational therapy students attending an online foundational occupational therapy course. Treatment included weekly completion of either a concept map or a set of three question-and-answer homework assignments over a period of three weeks. Findings suggested that accountability homework assignments of either type were helpful in promoting achievement. Results further revealed that satisfaction and perceived learning were greater in the concept map group as compared to the question-and-answer group. It is recommended that occupational therapy and other allied health instructors use accountability homework to reinforce student learning in the flipped classroom. The use of concept map assignments in particular has the potential to improve schema acquisition, critical thinking, and deep learning, which in turn can support educational success.

Introduction

The COVID-19 pandemic has affected every aspect of life, including how higher education coursework is delivered. Synchronous and asynchronous online classes, already a growing trend in education, have become ever more necessary and prevalent. To meet the challenges that accompany online learning, it is vital for educators to develop approaches to optimize student learning in virtual environments. Lecture-based instruction and other models that have been entrenched methods for in-person classrooms often do not effectively translate to synchronous online classes. Students report decreased attention span, difficulty focusing on content learning, limited engagement, and decreased motivation to ask questions and process material when accessing live lectures via video conferencing platforms (Mukhtar et al., 2020). To maximize the effectiveness of online learning, cultivating pedagogical approaches that increase student accountability and engagement is paramount.

The use of a flipped classroom structure is one innovative approach receiving increased attention in the current educational climate (Hwang et al., 2019). In a flipped class, lecture content is video recorded by the instructor and then accessed by students on the course learning management system (LMS). Video lectures act as preparation for synchronous sessions, and students are expected to view lecture content prior to class time. When the class meets (either virtually or in person), students are thus prepared for learning activities and engagement.

By moving the lecture portion of the coursework out of the classroom, the flipped classroom structure enables students to engage with the instructor and peers during class. The goal of class time is application and problem solving of topical content, discussion and clarification of information, schema development, instructor consultation, and peer collaboration on course projects and papers (Låg & Sæle, 2019). The instructor shifts from a role of content delivery expert or *sage on the stage* to one of knowledge acquisition facilitator or *guide on the side*. The flipped classroom maximizes opportunities for meaningful student-instructor interaction because work time occurs during class time.

As the flipped classroom approach gains traction in higher education, a resulting challenge is to ensure students have prepared adequately before class by watching video lectures and reading textbook material (Hawks, 2014). Building familiarity with content and developing a foundation of prior knowledge is crucial to the success of the flipped classroom. Although lecture videos can be accessed after class time to good effect, preparedness before class is crucial to class productivity and student learning. One method for facilitating pre-class preparation is to require low-stakes homework assignments be completed prior to class time. Designed to increase the likelihood that students will watch lecture videos and read before class, modest homework submissions are a reinforcer for students who are often short on time and have many competing academic demands. An added benefit of these homework assignments is that the instructor can review them prior to class and then consciously target class time

to concept and content review. Therefore, finding effective ways to reinforce student accountability in the online flipped classroom is vital to successful implementation of this innovative class structure.

Literature Review

Online Education

Digital educational opportunities have grown exponentially in the past two decades and have become ubiquitous in all fields of study including occupational therapy (OT; Lyons et al., 2020). Virtual classrooms provide flexibility for instructors and students, render geographic barriers inconsequential (so long as an internet connection is available, operational, and accessible), and encourage students to attend school and connect beyond their immediate locations (Reeves et al., 2017). Online opportunities also lower the cost of education as brick-and-mortar classrooms are not necessary for educational coursework (Green et al., 2017).

Despite the advantages of online education, digital platforms also present drawbacks. A central disadvantage and criticism of online environments is the paucity of social connection between classmates and between the student and the instructor. Lack of in-person schooling impacts healthcare education in particular, as hands-on experiences are vital for academic and professional success (Muflih et al., 2020). Online students may also experience decreased motivation and engagement in a virtual classroom, leading to detachment from the learning process and subsequent lack of successful performance and achievement (Hampton & Pearce, 2016).

Effectiveness of the Flipped Classroom

The flipped classroom aims to diminish the challenges of online education by utilizing digital resources combined with human interaction. The flipped structure involves students engaging with asynchronous learning through prerecorded video lectures and other online resources before engaging in application and evaluation activities during synchronous class time (Bates et al., 2016). Numerous disciplines including the sciences, technology, engineering, and mathematics (STEM) fields and the social sciences have successfully adopted use of the flipped classroom (Hwang et al., 2019). Healthcare fields and allied health programs have also integrated the flipped classroom model into programs with positive results (Zhu et al., 2020; Park et al., 2020). When compared with a traditional lecture approach, the flipped model has been found to provide a superior method for optimizing critical thinking and active engagement (Musni & Garrett, 2021), as well as student achievement (Låg & Sæle, 2019; Missildine et al., 2013). Optimally, the flipped classroom affords students and instructors a practical and efficacious means for amplifying the strengths of online, hybrid, and on-ground (in person) learning opportunities.

The success of the flipped classroom is due in large part to the availability of and access to on-demand video and multimedia lecture presentation materials. Video content is more immediately engaging than printed materials and thus enables students to focus and stay engaged with topics (Hampton & Pearce, 2016). Contemporary

students are often digital natives who gravitate toward video content to reinforce learning and study for exams. Many students use multimedia presentations as the primary source of information and only use textbooks and slide decks to reinforce learning after class sessions (Vasquez & Chiang, 2016). Findings from a recent study suggests that video lectures are superior to slide decks alone, and that students demonstrate the greatest retention and understanding when both video lectures and slide decks are available (Robertson & Flowers, 2020). Students who engage in active learning opportunities like discussions, application activities, and small group presentations in class after having watched video lectures during the asynchronous preparatory time reported more classroom motivation and increased course achievement (Bates et al., 2016).

Accountability in the Flipped Classroom

Adequate pre-class preparation critical to ensuring the flipped classroom provides an effective pedagogical approach to higher education (Tune et al., 2013). Instructors can facilitate pre-class preparation by assigning low-stakes homework to increase accountability. Independent student video viewing followed by the completion of a short homework assignment for review can be an effective reinforcer for students, especially for those who may be short on time or have many competing academic demands (Agarwal et al., 2019). Designing preparatory assignments that are engaging and useful for students can be a challenge, but it is one that educators need to address if a flipped classroom is to be maximally successful.

Homework Options in the Flipped Classroom

Instructors assign homework for a variety of reasons. Homework goals include pre-learning, checks for understanding, rehearsal of rote fact memorization, content processing, and schema building (Rosario et al., 2019). For healthcare students, homework must also be useful for exam study and to spur deeper learning for applied class papers and projects. Homework methods are varied and include re-reading slide decks, highlighting, paraphrasing notes, writing multiple choice questions with answers and rationales, creating visual displays, participating in online discussion boards with prompts, creating flashcard decks, or otherwise examining the information presented (Wynter et al., 2019). Regardless of the method, effective homework assignments require students to actively manipulate content to promote greater mastery of topical and conceptual information.

Multiple Choice Question Development

Writing multiple choice questions (MCQs) about a topic is a widely used learning tool to improve student achievement, especially when students are required to provide four plausible answer choices and a rationale for each answer choice (Riggs et al., 2020). MCQs with strong alternative answer choices enhance the process of information processing and improve student exam scores and class grades (Little & Bjork, 2015). Writing rigorous MCQs for homework can improve retention and retrieval of learned content and well-crafted multiple-choice questions may promote critical thinking skills by encouraging application and synthesis of knowledge (Zaidi et al., 2018). A drawback of MCQs concerns the needed skill set to construct high quality questions with plausible

answer choices. Content mastery is not dependent on the ability to write quality MCQs, and students may therefore experience unnecessarily high levels of cognitive load from the task. Despite the demonstrated efficacy of MCQ homework, little is known about how student satisfaction, perceived learning, or exam preparation is enhanced through the use of MCQ assignments.

Visual Display Creation

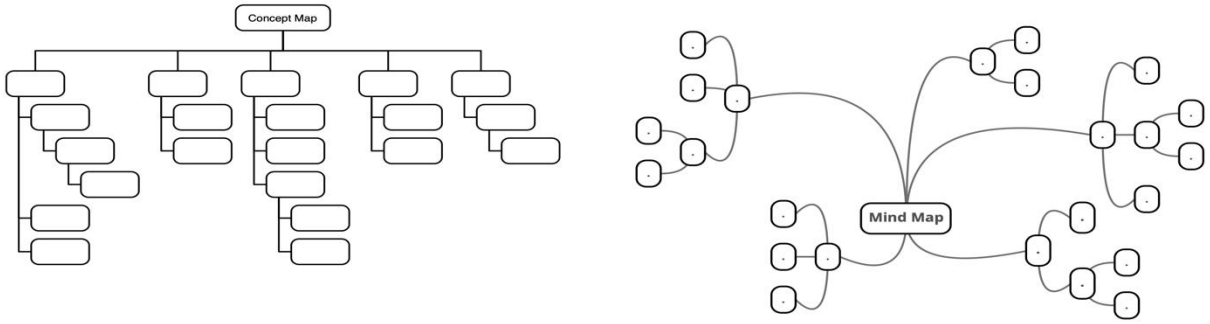
Manipulating information sufficiently to produce a visual display is a homework strategy designed to help students master topical concepts on a deeper level (Schraw & Richmond, 2022). Visual models come in numerous varieties including graphs, charts, tables, diagrams, drawings, content organizers, maps, and more (Rensink, 2009). Defining characteristics of visual displays include managing the amount of information to be processed, pairing graphics with textual information, and summarizing concepts to enhance understanding while limiting cognitive effort (McCrudden et al., 2011). Other key factors include structuring the display so that the viewer's attention is channeled to the most salient aspects of information and highlighting important interrelationships between the aspects of information (Schraw et al., 2013). For the purposes of this research study, two types of popular visual displays were examined: the concept map and the mind map.

Concept Maps. Constructed of shapes—called nodes—that contain words or short phrases, and links that connect ideas to each other, concept maps organize content into logical patterns that provide an overview of a topic. Nodes at varying levels of the map offer key details and the more levels present, the more detailed the map. Concept maps are created hierarchically; that is, with the main topic at the top of map and increasingly more detailed information arranged beneath the main topic. Figure 1 provides a sample of the structure of a concept map. Visual signaling using color scheme, images, node size and shape, or font style enhances viewer understanding of the map by providing patterns and structure to the map (Israel et al., 2020). The spatial arrangement of concept maps has been shown to increase schema formation and deepen learning (Nesbit & Adesope, 2013). General findings from research on concept maps suggest the structure of the map also augments critical thinking and encourages greater engagement with complex topics (Israel et al., 2020; Jaafarpour et al., 2016).

Mind Maps. Another commonly used visual map display, the mind map enables the viewer to connect new knowledge to prior knowledge, and to organize topical information to enhance learning (Ying et al., 2017). A mind map is organized with the main topic node situated as a central hub in the middle of the map and the detail nodes radiating out from the hub like spokes on a wheel. Figure 1 shows a sample mind map and contrasts it with a concept map. Like concept maps, mind maps can be created using visual signaling (e.g., applying a color scheme, using node shape or font type, etc.) to enhance the viewer's understanding of the diagram. Research on the use of mind maps as an educational strategy suggests it provides an effective tool to augment information retention and critical thinking in students (D'Antoni et al., 2010; Kalyanasundaram et al., 2017).

Figure 1

Examples of *Concept Map and Mind Map Structure*



Concept Map Mind Map

Comparison of Concept Maps and Mind Maps. The terms concept map and mind map often are used interchangeably to refer to any visual display that is constructed from nodes and links. Indeed, concept maps and mind maps have much in common with regard to their structure and purpose. The two displays each provide a conceptual overview along with key details related to a topic. Additionally, each type of display is illustrative of the web of knowledge a learner must develop to fully grasp and master conceptual content. Finally, the main objective in using either type of map is to encourage students to manipulate information for the purpose of increased retention and deeper understanding and learning (Davies, 2011).

Although mind maps and concept maps share many characteristics, there are also notable differences between the two types of visual display. A primary distinction is the presence or absence of a hierarchical configuration within the map. The concept map has a top-down structure that lends itself to displaying the systematic relationships between information about a topic (Novak, 2010; 2013). Conversely, the mind map has a radial structure, which lends itself to a more freeform means of exploring and displaying information and the connections between ideas (Erdem, 2017). In a comparison of types of visual displays, Eppler (2006) argued that the different structures of the concept and the mind map result in the two being suited for slightly different purposes. The hierarchical structure of the concept map is ideal for rapid information provision encapsulated in a single display. Concept maps enable the learner to unpack complex concepts and to examine the components, and connections between components, that make up the topic as a whole. Conversely, the freeform structure of the mind map lends itself to a more general exploration of a topic. Due to its non-linear structure, the mind map can easily be edited to include additional information, although connections between information may not be as clearly depicted.

Efficacy of Concept Maps and Mind Maps as Learning Tools. Concept maps and mind maps have been used to great effect in many healthcare education fields including nursing, pharmacy, and medicine (Daley & Torre, 2010; Daley et al., 2016; Powell, et al., 2021; Ying et al., 2017). A study conducted with physician assistant students compared the use of standard note taking to mind mapping. Results indicated that students who constructed mind maps performed significantly better on measures of critical thinking as compared with students who engaged in standard note taking activity (Israel et al., 2020). In the field of nursing education, concept mapping was compared to weekly quiz participation on measures of knowledge acquisition. Participants in the concept mapping group were found to have higher achievement on exams than students who took weekly quizzes (Jaafarpour et al., 2016). With regard to medical education, a recent study found that both mind maps and concept maps provided a more effective achievement tool than discussion activities for medical students learning about community public health issues (Choudhari et al. 2021). In the field of science education, Balim (2013) found that both mind maps and concept maps had a positive effect on achievement, and no significant differences in exam scores were noted between the two methods. Finally, in a study that examined the combination of mind mapping combined with a flipped classroom structure, Zheng et al. (2020) demonstrated statistically significant increases in achievement and notable gains in students' self-efficacy. Few studies focused on a comparison of the effectiveness of concept maps versus mind maps (Abbas et al., 2018; Redhana et al., 2021). In these studies, mind mapping was found to produce higher achievement. This small sample of studies suggests that mind maps and concept maps are both effective learning tools. The use of mind maps and concept maps may provide a beneficial approach to accountability homework, but this area of research has yet to be explored.

Limited research exists on the use of concept mapping or mind mapping in OT education. A search of healthcare and educational databases revealed only one article on the subject. In her qualitative study, Grice (2016) used concept map homework assignments in an entry level OT course to help students gain a deeper understanding of the topics being taught (Grice, 2016). Student-completed surveys indicated that the concept mapping homework was a valuable learning experience. Participants noted that concept maps facilitated organization, aided in comprehension, and encouraged deeper scrutiny of topics. The data suggests that concept mapping can be a useful learning tool in the OT classroom. Additional quantitative studies that focus on the relationship between concept mapping, student performance, and student satisfaction will further bolster the use of concept maps as a learning tool.

The purpose of the current study was to compare two preparatory homework strategies designed to increase student accountability in a flipped, synchronous online classroom setting. After watching video lectures and completing textbook readings, students were required to either create three MCQs and answers with rationales, or to create a concept map or mind map for the weekly topic. Effectiveness of the strategies for the student sample was based on the nature of engagement with the homework strategy, achievement, satisfaction, perceived learning, and ease of use.

Research questions guiding the study included:

1. In a flipped classroom, what is the nature of student engagement with and use of concept map or question-and-answer accountability homework?
2. In a flipped classroom, how does completion of concept map homework or question-and-answer homework affect student achievement?
3. In a flipped classroom, how does completion of concept map homework or question-and-answer homework affect student satisfaction, perception of learning, and ease of use?

Note: For the purposes of this study, the terms *concept map* and *mind map* were used interchangeably to reflect a node-link diagram and participants were welcome to create either type of map. For ease of discussion in this inquiry, both types of mapping homework will be referred to as *concept mapping*.

Methods

Study Design and Sample

In this experimental pilot study, first year OT students (n=46) enrolled in a foundational course at a large West Coast university were randomly assigned to one of two treatment groups. The experimental group completed concept map homework and the control completed multiple choice based question-and-answer homework (as had been done in the class in prior semesters). Each group completed three homework assignments over three consecutive weeks. Types of student engagement was examined via a rubric tallying details of each completed homework assignment (e.g., type of map, resources used, coverage of content, structure and depth of the homework products). Achievement was then measured using a regularly scheduled midterm exam. Satisfaction, perceived learning, and ease of use were measured using an online exit survey.

Educational Intervention and Treatment Groups

The setting for the study was the foundational course, *Occupation Through the Lifespan*, a class focused on learning about and linking ages and stages of development with occupational participation. The class also focused on the effects of disease and disability on occupational engagement. Study topics in the class focused on developmental theory, domain development, and occupational participation during the infant, toddler, and preschool stages of life. Subsequent topics not in the study included development through the remainder of the life span.

Preparatory video lectures consisted of 45-60 minutes of content per topic. Lectures were developed, recorded and edited by the instructor who was also the researcher. Slide deck content and presentation were guided by principles from the cognitive theory of multimedia learning (Mayer, 2021) and cognitive load theory (Sweller, 2020). Video links were available on the LMS and on a YouTube channel where all videos were hosted. Videos are available at: https://www.youtube.com/playlist?list=PLwPOQAIt1BDLciCqH6JI_Im4IJR71ws5E.

Each lecture was divided into 15–20-minute sections and uploaded as a discrete video. This chunking strategy was used to facilitate viewing short sessions of chapters of content which were hypothesized to be less overwhelming and more manageably viewed. Topics included developmental theory, domain development, and application to occupation for infant, toddler, and preschool-aged children. Each assignment was submitted for class credit but was not graded. Students viewed the videos on their personal device.

Following the necessary class preparation, the experimental group created a concept map about the video lecture and accompanying textbook chapter on the weekly topic. Using the same video lecture and textbook chapter topics, the control group generated three MCQs (each with four response options) and a short rationale for the correct answer choice. The control group completed the homework traditionally assigned in the class. Each group had one week to complete the homework assignments and they were due prior to meeting for synchronous online class sessions.

Outcome Measures

A regularly scheduled midterm exam was used to measure achievement. Four to five questions regarding each stage of development (infancy, toddler, preschool) were included in the exam. A multiple-choice structure was used and participants completed the exams online within the LMS environment.

Participant perceptions about the two types of homework were gathered via an online exit survey. The survey was created using information from the literature regarding the benefits and challenges of concepts maps as a learning tool (Daley et al., 2016; Jaafarpour et al., 2016; Nesbit & Adesope, 2013) and perspectives on college homework (Bembenutty & White, 2013; Young et al., 2016). Additional guidance in developing the survey was gathered via personal communication with Dr. Kimatha Grice (9/21/22) who authored the sole identified article about concept mapping as a learning tool in OT education (Grice, 2016). Dr. Grice shared her study survey and materials, and these documents informed the development of the survey for this study.

The survey was reviewed by OT faculty experienced in the use of concept maps for student learning, piloted with a small group of students, and revised based on feedback and results. Internal consistency of the survey was measured using Cronbach's alpha and was found to be good at 0.85. The survey included nine questions about participant satisfaction, ease of use of each homework method, and perceived learning. Additional questions about which concept mapping method was used were included for the concept map group. Both groups completed questions about their future use of the method and the perceived difficulty of the strategy. Participants completed the online exit survey at the end of the data collection period and the instructor/researcher did not have access to the results until after the class concluded and grades were submitted. Appendix A provides questions from the online exit surveys.

Procedures

Prior to completing homework assignments, participants were trained in either concept mapping or multiple-choice question development. Written instructions and short videos designed to teach each technique were provided. Participants in the concept map condition received information about two free, multi-platform apps to create concept maps (MindMup and XMind 2020). Participants also had the option to create their maps by hand and then to submit hand-drawn images as electronic files. If students chose to use an app, links to app-specific instructional videos were also provided. The instructor was available for technical assistance throughout the study. All preparatory material was uploaded to the LMS, assigned for review prior to the start of the study, and available throughout the three-week study.

In preparation for reviewing the homework assignments for the study, rubrics for the multiple-choice question-and-answer and concept map assignments were developed (see Appendix B). To be clear, the rubrics were not used for student grading, but solely to quantify the comprehensiveness, quality, and accuracy of the assignments. The rubrics were also used to measure various aspects of engagement with an assignment. For example, concept maps were reviewed for number of total nodes and number of levels of nodes. Multiple-choice questions and answers were assessed for structure of the questions. All assignments were scrutinized for sources used in completing the assignment and inclusion of references. Rubrics were completed by the research team. Participants who effectively completed the assignments received full credit for each submission. Participants did not have access to the rubrics or their rubric scores because the assignment score was not used in calculating grades, but only to differentiate levels of quality of the homework assignments for the study.

Question-and-answer homework was reviewed for quality of the stem, the answer alternatives (distractors), content sophistication and relevance, clarity, and comprehensiveness of the rationale. Additional information was gathered about question-and-answer structure, cohesion, and comprehensiveness of the three questions when viewed as a set. All submissions were examined for comprehensiveness of content coverage, sources used for the assignment, and inclusion of references.

Concept map homework was reviewed for map organizational strategy, coherence of the map, content comprehensiveness, and use of visual signaling to enhance accessibility and understanding. Concept maps were also reviewed for *map shock*– a state of confusion and mental overload that results from a map containing extremely dense content without an evident pattern to assist in navigating the map (Blankenship & Dansereau, 2000). Additional information was gathered about map structure, number of levels and nodes in the map, sources used for the assignment, and inclusion of references.

The study was approved by the Institutional Review Board for Human Subject Research at the university and all participants reviewed and signed a consent form. To reduce the risk of participant pressure to participate, the consent forms and online exit surveys

were collected by a colleague and were not available to the researcher until after the conclusion of the study and the end of the semester. Regardless of participation, all students completed the homework assignments, the exam, and the online exit survey. Consent enabled the researcher to use the student's data in the analysis. After the conclusion of the study, participants were trained in both types of homework assignments and invited to use either method for homework for the remainder of the semester.

Analysis

All participants (n=46) completed the respective homework assignments, exam, and the online exit survey. In addition to tracking descriptive factors (see Tables 1 and 2), rubrics (see Appendix B) were used to measure the quality and completeness of the homework. Two researchers completed the rubrics and an iterative process of discussing and agreeing upon interpretations of quality was then conducted. Interrater reliability for the scoring was established between the two researchers and averaged 0.90. Homework scores, test scores, and survey responses were analyzed using the Statistical Package for the Social Sciences (SPSS). Data analysis included descriptive statistics, t-tests, and Pearson's correlations.

Results

Nature of Engagement with Homework Assignments

The concept map group produced a range of homework products using a variety of approaches. The majority of the concept map group (93%) used mind maps rather than concept maps across the three homework assignments. This finding was likely due to the MindMup app producing a mind map. Participants preferred apps to hand drawn maps and 75% used the MindMup app rather than XMind. Sources of information used in the creation of the maps ran heavily to use of video lectures (78% across the three assignments) over the textbook (4%). The majority of participants used at least one form of signaling to delineate the structure and navigation of the map. Most participants used color as a signaling strategy.

The level of concept map detail was represented by the number of node levels. The mean for the first assignment was three and then increased to four or more levels of nodes for the following two assignments. The number of map nodes ranged from 6-106 across the three assignments with the median number of nodes ranging from 44-53. The median number of nodes increased on each subsequent assignment, suggesting that participants may have been developing a sense of the necessary level of detail for a map to adequately cover the given topic. Details are provided in Table 1.

Table 1

Concept Map Homework Nodes and Levels

Homework Assignment (n = 23)	*Number of Nodes (Median)*	*Number of Nodes (Range)*	*Number of Levels*	
Infancy	44	15-106	1-2:	17%
			3:	48%
			4+:	35%
Toddler	53	6-92	1-2:	17%
			3:	30%
			4+:	53%
Preschool	56	9-92	1-2:	22%
			3:	30%
			4+:	48%

The question, answer and rationale homework assignments indicated comprehensive content coverage for each set of three homework products and across the three assignments. Participants scored a mean of 87% for completeness of content coverage. The MCQs and answers necessitated writing question stems and four response options. The majority of participants wrote stems that asked a question (versus fill-in-the-blank) and largely avoided *all of the above* and *none of the above* options, suggesting a higher level of quality. In contrast with the concept map group, the question-and-answer group used either the textbook (37%) or the combination of text and video lecture (51%) to a much greater extent. Only a small proportion of the participants used video alone (12%). Details can be seen in Table 2.

Table 2

Comparison Between Multiple Choice Question and Concept Map Homework Assignments on Sources of Information Used and Inclusion of References

Homework Assignment and Group *(n = 46)*	Source of Information		
	Video Lecture	*Text*	*Video & Text*
Infancy			
Concept Map	65%	9%	26%
Multiple Choice Questions	9%	56%	35%
Toddler			
Concept Map	87%	4%	9%
Multiple Choice Questions	17%	22%	60%
Preschool			
Concept Map	83%	0%	17%
Multiple Choice Questions	9%	34%	57%

Note: CM = concept map, MCQ = multiple choice questions

Achievement from Homework Strategies

Data analysis revealed that both the concept map and the question-and-answer homework groups received strong scores on the test of achievement, with each group earning identical mean exam scores of 83%. Findings suggested the type of homework used to increase accountability did not affect achievement. Similarly, the quality of the homework did not correlate with achievement scores. Results suggested that homework of any type and quality was helpful in enhancing achievement.

Participants' exam study strategies were likely more responsible for exam scores than was the completion of homework of either type; a hypothesis that bears future research. For the concept map group, use of a hand drawn approach did not result in any significant differences from use of an app, although the small sample size may not have provided sufficient sensitivity to show a difference. Without the inclusion of a control group who did not complete homework, it is difficult to ascertain the basic effect of having homework, although logic would suggest that more exposure to the material would yield increased achievement.

Survey Results Reflecting Satisfaction, Ease of Use, and Perceived Learning with Homework Strategies

Online exit survey responses were used to examine student perspectives about satisfaction, ease of use and perceived learning with each of the homework strategies. The survey included questions with fixed answer options and questions that required text-based replies. Although the level of achievement did not vary meaningfully between the two treatment groups, students indicated statistically significantly more satisfaction and perceived learning from producing concept maps than from generating questions and answers. Ease of use did not vary between groups. Details are shown in Table 3.

Overall, participants were satisfied with the process of creating concept maps. Survey responses indicated participants viewed the mapping process and products positively. Participant replies indicated that the concept map creation was satisfying due to the inherent process and the opportunities for information integration and synthesis. Additional responses suggested creating maps was a worthwhile use of time. Cohen's d effect size for satisfaction indicated a medium-large measure of practical importance at d=0.74.

Survey responses also showed that participants perceived a greater amount and higher quality of learning from the concept maps compared to the question-and-answer assignments. Survey responses revealed the participant perspective that concept maps facilitated learning and would be a useful resource for studying for the exam. Cohen's d effect size for perceived learning indicated a medium-large measure of practical importance at d=0.69. These results suggest that concept maps are an effective approach to homework and accountability in the flipped classroom.

Table 3

Descriptive Statistics and Independent T-Test for Participant Satisfaction, Perceived Learning, and Ease of Use of Concept Maps Versus Multiple Choice Questions Homework Assignments

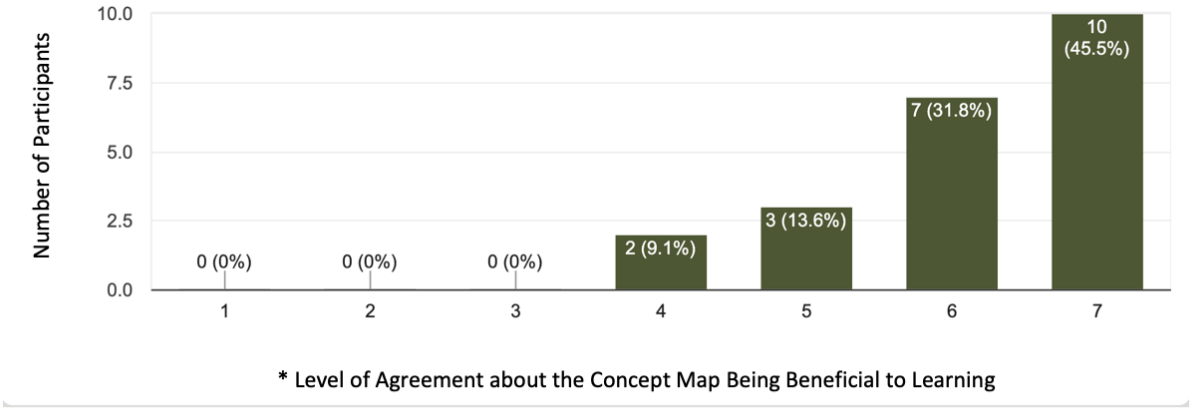
	CM Group (n = 22)		MCQ Group (n = 21)					
	Mean	*SD*	*Mean*	*SD*	*F*	*df*	*p*	*Cohen's D*
Satisfaction	15.95	3.63	13.33	3.48	.163	41	0.02*	0.74
Perceived Learning	26.36	3.23	23.86	4.07	.198	41	0.03*	0.69
Ease of Use	16.09	3.24	15.43	3.82	.865	41	0.54	0.19

Note: CM = concept map, MCQ = multiple choice questions
*Statistically significant at .05 level while controlling for overall error rate

Although participant responses indicated that concept maps are beneficial to learning and provide an advantageous study tool, this perspective did not strongly translate into behavior around exam preparation. Figure 2 illustrates strong support for learning gained from concept map homework. In contrast, Figure 3 shows more mixed responses about using the concept map as an exam study tool. The disagreement between the two responses offers an avenue for future investigation.

Figure 2

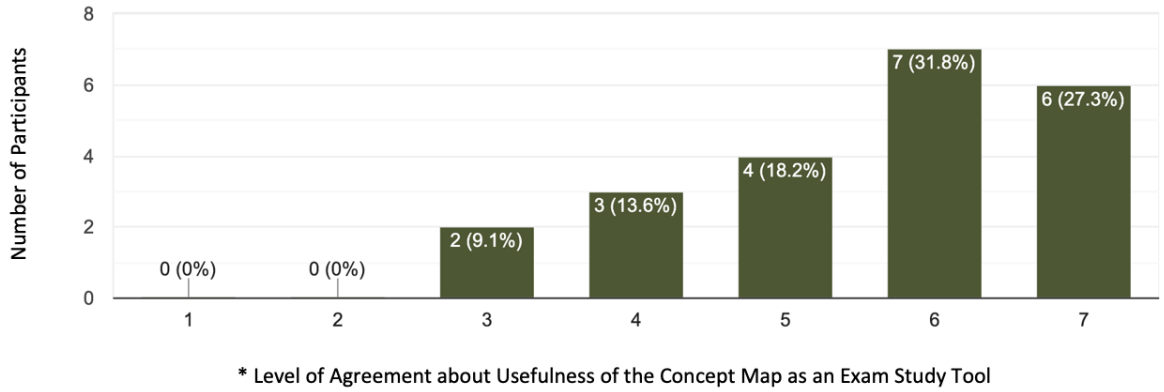
Survey Question About Learning Gained from Concept Map Homework



* Level of agreement with statement ranges from 1-7.
A score of one represents no agreement and seven represents extreme agreement

Figure 3

Survey Question About Concept Map Homework Becoming an Exam Study Tool



* Level of agreement with statement ranges from 1-7.
A score of one represents no agreement and seven represents extreme agreement

Online exit survey responses about the question-and-answer assignments suggested participants generally liked the homework method and believed it was beneficial for learning. Participants experienced some difficulty in creating the assignments with comprehensive content coverage being a particular challenge. Responses about the question-and-answer assignments providing a beneficial study resource for the exam and the structure of the assignment fitting student learning needs were mixed. Participants in both groups felt adequately trained to create concept maps or question-and-answer homework assignments.

Discussion

This research study investigated strategies for enhancing active learning, engagement, and accountability in the flipped classroom. Two types of homework assignments– creating concept maps or writing MCQs and answers– were compared on measures of engagement, achievement, satisfaction, perceived learning, and ease of use. Findings indicated that both homework methods resulted in solid achievement, suggesting that accountability assignments are an asset in the flipped classroom. Results also revealed that when feasible, students tended to use video rather than textbooks in their class preparation. This finding, while not surprising given the effects of the digital age, suggests that reliance on textbooks in higher education may need to be reevaluated considering the plethora of available and often low-cost or free online educational and multimedia resources. Finally, findings showed that the concept map homework produced greater satisfaction and perceived learning than did the question-and-answer homework.

Use of Learning Resources

Student engagement, satisfaction, and perceived learning from the assigned homework method resulted in part from the resources used to initially learn the topical content and concepts. To some extent, subsequent student achievement also relied on learning

resources accessed. Students had free choice among the available learning resources: textbook, additional information provided on the LMS, slide deck files, and/or video lectures. Although it is beyond the scope of this study, the student-chosen methods of acquiring information were fascinating and speak to the changing nature of learning in higher education.

Findings indicated that almost 80% of participants who completed concept map assignments used video lectures to prepare and largely disregarded textbook review. Conversely, students who completed the question-and-answer homework demonstrated the opposite pattern with the majority of information for the homework being gleaned from the textbook. A likely explanation is that the question-and-answer homework was most easily completed by isolating facts from the textbook, rather than engaging in the larger time commitment required from watching video lectures. The concept maps required a broader understanding of the content which was more effectively obtained through watching video and referencing the companion slide deck. The concept map findings echo those from recent research from Ruggieri (2020) about patterns of student use of text and online resources in a physics course. Researchers found that students preferred and engaged more readily with online resources than textbooks, only defaulting to textbooks when absolutely necessary. Further, free video-based options like YouTube and Khan Academy were highly preferred.

Textbooks

Historically touted as the resource of choice for college students, textbook use has waned in recent decades (Wynter, et al., 2019). The current research offers confirmatory evidence of lagging textbook use, as a small minority of students in the concept map group used the text for class preparation. In the question-and-answer group, textbook usage was higher, but primarily for accessing discrete factual information rather than to learn conceptual knowledge. For instructors, the paucity of textbook use presents a concern and a challenge, as textbooks offer a repository of topical knowledge contained in one convenient package.

One overwhelming reason for decreasing textbook use is the prohibitively high cost of accessing textbooks. In a survey of over 2000 students from 150 college campuses, researchers found that 65% of students did not purchase textbooks because of the high cost (Nagle & Vitez, 2020). Between 2006 and 2016, textbook costs rose a staggering 88% (Bureau of Labor Statistics, 2018). The up-front cost of books and the slim possibility of selling them back to bookstores make textbook purchase or rental an undesirable option for many students.

Once accessed, the use of textbooks is curtailed by a range of factors. Lack of time, decreased motivation, or an underestimation of the importance of reading can all limit book use (Kerr & Frese, 2016). Students also indicate that their myriad responsibilities in and out of school limit their ability to complete assigned reading across courses in a timely manner (Hoeft, 2012). Students may also lack the metacognitive skills to effectively evaluate readings (Berry et al., 2010). Evidence suggests that effective comprehension is also a barrier to textbook use, as in a recent study, only half to two

thirds of college student participants understood or could paraphrase what they read (Hoeft, 2012). Attitudes about textbook use are similar to those voiced by students as they engage with their educational program. Throughout the semester, this instructor/researcher fields frequent comments and questions about the challenges of completing all of the assigned readings and that students have difficulty understanding dense text. The limited use of the textbook in this study was a surprising finding and is one that bears additional investigation in future research.

Online Educational Resources (OER)

In higher education, the use of OERs including video, animations, online lectures, simulations, and e-books is exploding (Ruggieri, 2020). Students can engage with OERs at their own time and pace and access is easy and free on any internet-enabled device (Nusbaum et al., 2020). OERs are well aligned for the current educational milieu. Access is familiar and easy because the structure of OERs mimic student interaction with online social media, news, and entertainment. Additionally, the truncated attentional demands of OERs are in alignment with pace and viewing habits of today's college students.

On-demand access and restricted attentional demands likely contributed to participant preferences for video lecture in the concept map condition. Public posting on a ubiquitous sharing site enabled students to easily stream the lecture videos on any device and to watch anywhere and at any time. Additionally, catering to limited participant attention by dividing the 45–60-minute video lectures into separate 15–20-minute chapters enabled students to view the entire presentation in short, self-paced sessions. The multimedia principle of segmenting, which suggests students learn more effectively when a multimedia message is presented in user-paced segments rather than as a continuous unit, provided guidance for the format of the video lectures (Mayer, 2021). The segmenting principle of multimedia learning theory is strongly supported in education (Mayer et al., 2018; Mayer & Pilegard, 2014). The combination of easy access and segmenting encouraged students to use the video lecture resources consistently.

Satisfaction from Concept Map Homework

Satisfaction is a documented predictor of student success (Gray & Diloreto, 2016), and student satisfaction from the concept map homework was strong. Results from this study reaffirm findings of existing literature that suggests student satisfaction and self-efficacy around educational efforts increase when concept maps or mind maps are used (Harpaz et al., 2004; Ying et al., 2017).

Participants in this study may also have experienced gratification from building webs of conceptual knowledge. This process, known as schema acquisition (Kalyuga, 2010), involves linking existing knowledge to new learning to aid in comprehension. The schema acquisition process mirrors the concrete web of knowledge created by making a concept map. Although the topic has not been well-documented in the literature, there are connections between student self-efficacy, satisfaction, and achievement (Doménech-Betoret et al., 2017; Jung et al., 2022). The process can be highly satisfying

as one participant noted in their text comments from the survey, "...To the benefit of the mind map, PowerPoints don't show the connections between the topics as easily as a mind map. I think this will prove useful for my better understanding of relationships between ideas". Another participant shared, "I liked creating and utilizing the concept maps. I think it helps to build connections between the various subjects I was learning… a good way to visually organize lots of information." Allied healthcare literature supports use of this process and suggests that the structure of concept maps promotes organization and integration of information, as well as encouraging critical thinking and problem solving (Israel et al., 2020).

Although creating concept maps was satisfying, some participants also found the process time consuming. One participant commented, "I think I like the concept map better than creating questions, I get a better overall review of the information, although it does take much longer." The literature on the effective use of study time as it relates to perceived learning and achievement (Deslauriers et al., 2019; Walck-Shannon et al., 2021) highlights the need for students to learn and use active and effective homework strategies, even when they may take longer than less active engagement with conceptual class material. For concept map homework to be a well-accepted homework approach, students' time commitment must translate into awareness of the usefulness of concept maps as a learning resource and exam study guide.

The sporadic use of concept maps for exam preparation was another identified issue related to participant satisfaction. The findings suggest that students did not know how to translate the information on their maps into a workable review guide. Incoming graduate students may not have high school or undergraduate study habits that support graduate school learning demands. According to recent research (Chen et al., 2017; Stokhof et al., 2019), active learning engagement, student questioning, self-regulated learning strategies and self-reflection are key to linking study efforts with achievement. Therefore, to increase use of concept maps as a foundation for exam study, it is recommended that instructors explicitly unpack the process. Ironically, students in the course requested study guides for exams, and these documents consisted of terminology and concepts that were most assuredly included in their concept maps. An area of future research is an investigation of how to link concept map homework to the use of concept maps as a study tool.

Perceived Learning from Concept Map Homework

Common predictors of perceived learning include a) self-efficacy as evidenced by a willingness to face academic challenges; b) time management and organizational abilities including planning for due dates; c) adapting to various learning expectations; and d) an ability to engage in self-evaluation of assignments when given instructor created criteria for reflection (Alqurashi, 2018). These constructs reflect a variety of self-regulated learning strategies which support student learning potential. Self-regulated learning is an umbrella term that contextualizes the metacognitive, behavioral, social, and emotional processes involved in learning (Muijs & Bekhove, 2020; Panadero, 2017; Zimmerman, 2002). The results from this study revealed that perceived learning was greater in the concept map group than in the question-and-answer group. This finding

suggests that participants were tapping into self-regulated learning processes. Self-regulated learning and especially the meta-cognitive skills of monitoring and directing are needed to propel basic recall into the more sophisticated processes of application, problem solving, and transfer. Evidence of self-regulated learning bodes positively for students engaged in the complex content learning in OT programs.

Limitations of the Study

In this study, the relatively small sample size limits the generalizability of the results. Additionally, restricting participants to one treatment condition may have produced fewer compelling results than if each participant completed homework using both types of intervention. The exam content presented a third limitation, as the test was focused more heavily on recall of facts rather than on measurement of conceptual knowledge. This resulted in a measure of achievement that did not optimally isolate the higher-level skills of problem solving and application of complex content.

Implications for Occupational Therapy Education

The active learning approaches found in flipped classrooms are often more effective for promoting deep learning than passive approaches found in lecture-only classes (Freeman et al., 2014; Harris et al., 2019). Although active learning increases student engagement and mastery of content, the cognitive effort involved in synthesizing knowledge can be taxing and is thus interpreted as less actual learning (Porter, 2013). This disconnect may occur because the fluency of high-quality lectures paired with instructor expertise is erroneously equated with increased learning (Deslauriers et al., 2019). Novice learners may also struggle to accurately judge how much or how well they have learned due to lack of prior knowledge and limited experience with cognitive effort (Carpenter et al., 2013). Therefore, it is recommended that instructors explicitly associate the cognitive challenge of active learning with the benefits produced. Creating low stakes, formative activities that reward participation and risk taking may help with this effort. Administering an assessment early that enables students to gauge their actual learning early in the semester is also recommended.

Quality learning is also dependent on effective preparation, which supports in-class engagement and participation. The research findings underscore the importance of pairing student class preparation with homework assignments to encourage accountability. Results indicated that homework also contributed to successful achievement on exams. To facilitate course success, instructors are encouraged to make use of student-created concept map homework rather than question-and-answer homework, as superior satisfaction and perceived learning resulted from the method.

Findings also suggested that textbooks, which historically have been a quintessential preparatory resource, may no longer be relied upon as the key foundational resource. A willingness to curate and integrate (if not create) video and other online resources appears a vital addition for the contemporary healthcare educator. Self-education about multimedia theory and the pragmatic use of educational technology in the online classroom will further enhance the effectiveness of OT instructors working in online and flipped classrooms.

Conclusion

As online educational opportunities continue to increase, honing innovative instructional strategies for engaging and motivating students becomes ever more important. Flipping the online classroom and offering increased active learning opportunities provides one promising approach. Bolstering effective preparation in the flipped classroom by using carefully crafted homework assignments is another strategy. Finally, making use of concept maps to increase schema acquisition, critical thinking, and deep learning can offer learners an invaluable opportunity to support achievement, learning satisfaction and educational success.

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Appendix A

Homework Feedback Survey

Concept Map Online Exit Survey

Note: the first nine questions survey participant satisfaction, ease of use of the concept map homework, and perceived learning. An additional eight questions about the use of various concept mapping methods and the difficulty of these approaches are at the end of the survey.

Question Number	Factor Measured	Statement and Factors Measured	Response Options
1	Satisfaction	"I liked completing the concept map homework."	Choose level of agreement on a scale from 1-7. 1 = not at all in agreement. 7 = extremely in agreement).
2	Perceived Learning	"I found the concept map homework to be beneficial to my learning."	
3	Ease of Use	"I found it easy to use the concept map for homework."	
4	Ease of Use	"I found the concept map difficult to create."	
5	Perceived Learning	"The concept map facilitated my learning of the topic."	
6	Perceived Learning	"The concept map was a useful tool for studying for the exam."	
7	Satisfaction	"The concept map was a waste of time."	
8	Perceived Learning	"The concept map was a good fit for how my brain makes sense of new information."	
9	Perceived Learning	"The concept map was not a good fit for my preferred learning style."	
10	Satisfaction	"I am likely to independently use a concept map for my studies."	
11	Ease of Use	"I felt adequately trained to use the concept map as homework."	

12	–	“I used the following app to make my concept maps.”	Select an option: MindMup XMind Both Old School/Paper and Pen/Pencil
13	–	“If you hand drew your map, please indicate why you made this choice and how it might facilitate your learning or studies. If you used an app, please indicate N/A.” (Participant typed text reply)	Type reply.
14	–	“If you used an app, please indicate how you decided which app, why you made this choice, and how it might facilitate your learning or studies. If you hand drew your map, please indicate N/A.”	Type reply.
15	Ease of Use	“The concept map was difficult to use.”	Select an option: Extremely difficult Very difficult Somewhat difficult Minimally difficult A little bit easy Somewhat easy Very easy Extremely easy I did not use an app (I hand drew my maps)
16	Ease of Use	“The concept map app had intuitive navigation and tools.”	Extremely intuitive Very intuitive Somewhat intuitive A little intuitive A little unintuitive Somewhat unintuitive Very unintuitive Extremely unintuitive I did not use an app (I hand drew my maps)
17	–	“Any other comments on your experience of the concept map as a learning tool?”	Type reply

Multiple Choice Question and Answer Homework Feedback Survey

Note: the first nine questions survey participant satisfaction, ease of use of the concept map homework, and perceived learning. An additional three questions about the use of multiple-choice question/answer homework and the difficulty of this approach are at the end of the survey.

Question Number	Factor Measured	Statement	Response Options
1	Satisfaction	"I liked completing the multiple-choice question/answer homework."	Choose level of agreement on a scale from 1-7. 1 = not at all in agreement. 7 = extremely in agreement).
2	Perceived Learning	"I found the multiple-choice question/answer homework to be beneficial to my learning."	
3	Ease of Use	"I found it easy to use the multiple-choice question/answer format for homework."	
4	Ease of Use	"I found the multiple-choice question/answers difficult to create."	
5	Perceived Learning	"Developing the multiple-choice question/answers facilitated my learning of the topic."	
6	Perceived Learning	"The multiple-choice question/answers were a useful tool for studying for the exam."	
7	Satisfaction	"The multiple-choice question/answers were a waste of time."	
8	Perceived Learning	"The structure of multiple-choice question/answers was a good fit for how my brain makes sense of new information."	
9	Perceived Learning	"The multiple-choice question/answers were not a good fit for my preferred learning style."	
10	Satisfaction	"I am likely to independently use a multiple-choice question/answer format for my studies."	
11	Ease of Use	"I felt adequately trained to use the multiple-choice question/answer format as homework."	
12	–	"Any other comments on your experience of the concept map as a learning tool?"	Type reply

Appendix B

Rubrics for Concept Map and Multiple-Choice Question and Answer Homework

Note: used to determine homework quality only. Not used for student grading.

Concept Map Rubric

I. Map Organization	*INF	*TOD	*PRE
More general and overarching concepts are higher (CM) or more centrally situated (MM) on the map than concepts subsumed by the general concept	/ 3	/ 3	/ 3
Child nodes elaborate on parent nodes	/ 1	/ 1	/ 1
Map has visual balance or symmetry	/ 2	/ 2	/ 2
System of classification is visually clear and logical and related nodes are grouped spatially	/ 3	/ 3	/ 3
Legible, sized and shaped effectively for viewing	/ 1	/ 1	/ 1
	/ 10	**/ 10**	**/ 10**
II. Coherence - Extraneous Materials Excluded			
Limited number of words in each node and focus is on key terms/concepts	/ 2	/ 2	/ 2
Limited cross links and lengthy links	/ 1	/ 1	/ 1
Map shock is avoided - (number of nodes/links is limited and/or spatial organization promotes the usefulness and readability of the map)	/ 2	/ 2	/ 2
	/ 5	**/ 5**	**/ 5**
III. Content (Based on Summary of Lecture or Textbook)			
Comprehensiveness (Must include theory): 90-100% = 10 80-89% = 8 70-79% = 6 60-69% = 4 50-59 %= 2 Under 50% = 0	/ 10	/ 10	/ 10

Content Organization (map has a consistent and clear arrangement of content that augments understanding of concepts)	/ 5	/ 5	/ 5
Comments:			
	/ 15	**/ 15**	**/ 15**
IV. Visual Signaling to Enhance Accessibility			
Map has effective use of at least one of the following to differentiate topics/subtopics/sections of map: (if no visual signaling, score 0 here and for IV-B). *Color Coding*: Node or font color varies distinctively and/or map has a color scheme *Shape*: Node shape varies *Size*: Node or font size varies by topic and level (vs. fitting info into the node) *Font*: Font style emphasizes content/structure (e.g. bold, italics, underline, etc.) *Additional Images*: Added images or other factors are added to increase clarity	/ 5	/ 5	/5
Signaling strategy is logical and recognizable when viewing the map and contributes to map clarity	/ 5	/ 5	/ 5
	/ 10	**/ 10**	**/ 10**
Total	**/ 40**	**/ 40**	**/ 40**
Grand Total (3 maps)	**/ 120**		

* INF = topic of infant development, TOD = topic of toddler development, PRE = topic of preschooler development

Descriptive Factors

Type of Map	CM	MM	
Construction Type	MindMup	XMind	Hand Drawn
Number of Levels	1-2	3	4+
Total Nodes			
Source of Info	Video Lecture	Text Book	Both
References	Yes	No	

Multiple-Choice Question/Answer Homework Rubric

I. Stem	Q1	Q2	Q3
Stem is meaningful (i.e. includes conceptual knowledge)	/ 3	/ 3	/ 3
Clear, concise and minimizes irrelevant information	/ 2	/ 2	/ 2
	/ 5	**/ 5**	**/ 5**
II. Alternatives			
Correct answer is concise and clearly stated	/ 1	/ 1	/ 1
Distractors are plausible alternatives and homogenous in content	/ 3	/ 3	/ 3
Distractors are concise and clearly stated	/ 1	/ 1	/ 1
	/ 5	**/ 5**	**/ 5**
III. Content (Based on Summary of Lecture or Textbook)			
Content focuses on main concepts and avoids either overly general ideas or overly specific details (note if overly general or overly specific) Note: in scoring this item, ask yourself, "would this item be on an exam"?	/ 7	/ 7	/ 7
Content focuses on the following level of knowledge and learning: Basic recall = 5 Enhanced recall = 7 Application = 8 Note: Transfer, analysis and problem solving are the highest levels of knowledge but are not options because they require more time and familiarity with the content	/ 8	/ 8	/ 8
Comments:			
	/ 15	**/ 15**	**/ 15**
IV. Rationale			
Rationale provides additional insight and is clear, logical and paraphrased from the original source. Additionally, rationale ***may*** include one or more of the following:	/ 15	/ 15	/ 15

Reference to other materials Compares/contrasts concepts Clarifies and adds relevant information Analyzes or evaluates the material. Includes relevant quote Is understandable without rereading Q/A			
	/ 15	**/ 15**	**/ 15**
Total	**/ 40**	**/ 40**	**/ 40**
Grand Total (3 questions)	**/ 120**		

Descriptive Factors

Source of Info	Lecture	Textbook	Both
References	Yes	No	
Negative phrasing of questions (if no, skip item #4)	Yes	Sometimes	No
If negative phrasing is used, stems says, "except" vs. which is "not true"	Yes	Sometimes	No
Stems are questions vs. fill in the blank	Yes	Sometimes	No
Use of "all of the above" and "none of the above" is avoided	Yes	Sometimes	No
Set of three questions is cohesive and covers a range of relevant topics	Yes	No	