
Student Attitudes and (Lack of) Anxiety for Online Practice Quizzes

Dave Hochstein
Wright State Lake

While giving students practice quizzes has been associated with improvements in information retrieval from long term memory, whether a potential linkage with test anxiety exists is not well documented. Therefore, the objective of this study was to assess whether a potential positive link could be present. College students (n = 156) from a small rural university campus completed a survey collecting personal characteristics and information based on online practice quizzes for each of their current courses. Most students (95%) reported online practice quizzes did not increase test anxiety. Instead, students were likely to report these quizzes helped them to learn the material (94%) through reviewing/summarizing class material and helping with test preparation. Thus, for most students practice quizzes were identified as an effective method of test preparation.

Research examining the effectiveness of various study techniques typically demonstrates college students are more likely to use ineffective study strategies such as re-reading, or repeating key facts than more efficient strategies, such as retrieval practice (e.g. Hartwig & Dunlosky, 2012; Hochstein, 2018). Retrieval practice, such as that promoted by practice quizzes over test material, effectively gives students practice in retrieving specific information from long term memory (e.g. Roediger, Putnam, & Smith, 2011). Practice quizzes, in this context, are defined as quizzes offered to students without potentially causing a reduction in their final grade (e.g. Agarwal, D'Antonio, Roediger, McDermott, & McDaniel, 2014). Not surprisingly, researchers have called for the training of students in these more effective strategies by instructors in both K-12 and post-secondary settings (e.g. Agarwal et al., 2014; Dunlosk, Rawson, Marsh, Nathan, & Willingham, 2013).

A potential drawback of using practice quizzes is the potential increase of students' test anxiety, a possibility suggested by students themselves (e.g. Steele, 2011). After all, students would probably prefer to take fewer rather than more exams (as noted by Dunlosk, et al. (2013). This is important, as increased anxiety caused by interim, graded, pop-quizzes

has been associated with a reduction of test-enhanced learning on final tests (e.g. Hinze & Rapp, 2014; Khanna, 2015). Classroom based research on the amount of anxiety experienced by students taking online quizzes is sparse, however. While there is evidence suggesting students taking ungraded quizzes are not experiencing increased test-anxiety because of the quizzes, that research is based on in-class quizzes using clicker quizzes (Agarwal, et al., 2014), or non-scheduled traditional quizzes followed by discussion (Khanna, 2015; Khanna & Cortese, 2016). To the best of our knowledge, the current study is the first to examine the effect that online practice quizzes have on test-anxiety.

There were two primary research goals for this survey-based exploratory study. The first was to examine the students' self-reported anxiety associated with online practice quizzes, particularly students' perceptions on the impact practice quizzes had on their test anxiety levels. The second was to examine the students' perceived advantages to and dislikes of taking those same quizzes. Once these are explored, recommendations can be made to minimize those disadvantages and promote the advantages.

The survey for this study was originally designed to collect data about test anxiety and study strategies across a variety of classes for middle-school and high-school students (Agarwal et al., 2014). It was modified to include a range of course types and focus on online quizzes offered through Pilot, the WSU-Lake online learning management system (Desire2Learn). Components of quiz design (e.g. feedback and question type) varied according to individual faculty member's preferences. This modified survey was originally published in Hochstein, 2018. To maximize the number of weeks students had to report on, surveys were given within the last two to three weeks of the semester.

Method

Participants

The 152 participants in this experiment were the same participants from a rural, open-enrollment branch campus with 2-year and 4-year degree programs reported on in Hochstein, 2018. These college students (66 males (43%) and 85 females (56%)) ranged in age from 18 to 52 ($M_{\text{age}} = 21.02$ years, $SD = 4.77$). One participant declined to provide gender information. Participants ranged in their academic standing, with 55 (36%) indicating first-year status, 50 (33%) indicating second-year status, and 39

(26%) indicating greater than second-year status. Eight students declined to fill out academic standing information on the survey. Participant ethnicity was not included in the survey to increase confidentiality.

Recruitment was accomplished through convenience sampling of eleven courses to maximize the diversity of classes included in this sample. These included five general education courses (biology, economics, English, math, and psychology) and six higher level courses (2nd, 3rd, and 4th year courses in agriculture, mechanical engineering, office information systems, political science, regional studies, and teacher education). To minimize the potential for identifying information, courses had to have six or more students to be approached for study participation. Survey completion occurred two to three weeks before the final week of the semester, during the last fifteen minutes of a random class session. All participants were prompted to only complete the survey once and reminded their participation was voluntary. No incentives were given from the experimenter for participation.

Materials

The survey (see Appendix) was the same reported on in Hochstein, 2018. Information about course type (e.g., math, engineering), time spent studying for this course, and strategies used while studying for this course were collected for each of the classes participants were currently enrolled. Demographic information, such as age, gender, and academic standing, was also collected.

Participants reported on course type (from a list of 12) instead of the specific course they were enrolled in to increase confidentiality, with course types described through the names of general courses found within that type. Six of these types were based on required courses for general education courses at the University. The remaining six were based on the remaining major fields of study offered at the University. For a breakdown of these course divisions, see the Appendix.

Procedure

The procedure is the same as reported in Hochstein, 2018. Assent forms with a debriefing on the back were distributed by the experimenter. Participants were instructed to read the assent form, given a verbal explanation of the assent form, and told not to look at the debriefing until after survey completion. Participants were also reminded verbally and

through the assent form that their participation (or lack thereof) was voluntary, anonymous, and would not affect their grades. They were also told they could ask questions and leave early if they had already completed the survey or did not wish to participate. If the course they were reporting on had no exams, they were to count course presentations as exams. If the course they were reporting on had no exams and no presentations, they were told to not report on it. On average, the completion of surveys took eight minutes. Completed surveys were collected by the experimenter while the course instructor was either absent or in the back of the classroom.

Scoring

Scoring was the same as reported on in Hochstein, 2018. Participants were asked to indicate on a scale from 1 (no anxiety) to 7 (disabling amount of anxiety) how much anxiety (nervousness or stress) they experienced before a test in a particular class compared to their other classes. For the following analyses, which compare anxiety or strategy use between course types, student's reports for courses were treated as individual reports, as individual participants did not report enough multiple class types to make these comparisons between class types within individuals worthwhile. Class reports were not included in the analyses if they did not include required information (e.g., missing information about study time).

Results

Anxiety and Online Practice Quizzes

Participants were asked for each of their classes if online practice quizzes or exams were offered on the campus Desire2Learn website. When each of the students' class reports were treated as individual responses and pooled together ($n=584$), there were 139 (23.8%) reports of classes offering such online practice quizzes, with students reporting taking those online practice quizzes in 114 (82.0%) cases, not taking them in 22 (15.8%) cases, and not giving an answer in 3 (2.2%) cases. Overall, for those who reported taking available online practice quizzes ($n=114$), when asked if taking these online practice quizzes made them more or less nervous for class exams, 43 (37.7%) "Less" responses were given, 65 (57%) "Same" responses were given, and 6 (5.3%) "More" responses were given. A more fine-grained examination of these responses broken down by personal characteristics and course type consistently found this pattern of reporting practice quizzes

to not be associated with increased test anxiety. See Table 1 for a complete breakdown of these differences.

When participants indicated the impact online practice quizzes had on test anxiety, their reported anxiety for the class followed suit with lower test-anxiety associated with the “Less” responses ($n = 43, M = 3.14, SD = 1.61$) than associated with the “Same” ($n=65, M = 4.39, SD = 1.54$) and “More” ($n=6, M = 4.83, SD =1.94$) responses. This pattern of reporting was also consistently found when responses were broken down by personal characteristics and course type, when the number of reports for a particular group was greater than 1.

Table 1: Percent of Responses Indicating Taking Practice Quizzes Made Them Less Nervous, About the Same Level of Nervousness, or More Nervous for Class Exams.

	<u>Less</u>	<u>Same</u>	<u>More</u>
All Responses (114)	38%	57%	5%
Academic Status			
First Year (44)	50%	43%	7%
Second Year (42)	33%	64%	2%
Third Year or above (24)	25%	67%	8%
Content Area			
Acct/Bus/Econ/Org. Leadership (22)	41%	50%	9%
Engineering (30)	17%	80%	3%
Math/Statistics (14)	57%	36%	7%
Anat/Bio/Chem/Earth-Env/Phys (24)	42%	54%	4%
Poly Sci/Psych/Soc/Soc Work (14)	64%	36%	0%
Other (10)	20%	70%	10%
Gender			
Female (58)	41%	50%	9%
Male (56)	34%	64%	2%

Note. These reports are only from those indicating they took practice quizzes in the indicated class offered. Numbers in parentheses represent the number of responses. Percentages may not sum to 100% due to rounding. Four responses in this subset did not indicate academic status. Content areas with five or less responses are summed together under "Other."

See Table 2 for a further breakdown of these answers according to class type, course content area, and gender.

Table 2: Average Test-Anxiety Reported for Those Indicating Taking Practice Quizzes Made Them Less Nervous, About the Same Level of Nervousness, or More Nervous for Class Exams.

	Reported Less Anxiety			Reported Same Anxiety			Reported More Anxiety		
	Anxiety Reported	<i>n</i>	<i>D</i>	Anxiety Reported	<i>n</i>	<i>D</i>	Anxiety Reported	<i>n</i>	<i>D</i>
All Responses (114)	3.14	3	1	4.39	5	4	4.83	6	4
Academic Status									
First Year (44)	2.96	2	3	3.66	9	0	4.67	3	2
Second Year (42)	3.14	4	6	4.82	7	0	4.00	1	A
Third Year or above (24)	4.00	6	9	4.56	6	9	5.50	2	2
Content Area									

			1.			1.		0.	
Acct/Bus/Econ/Org. Leadership (22)	3.44	9	9	4.46	1	7	4.50	2	7
			0.			1.			
Engineering (30)	4.20	5	4	5.00	4	0	4.00	1	N
			1.			1.			
Math/Statis tics (14)	3.38	8	1	4.40	5	4	7.00	1	N
			1.			1.			
Anat/Bio/Chem/Earth- Env/Phys (24)	3.30	1	8	3.73	3	3	2.00	1	N
			0.			2.			
Poly Sci/Psych/Soc/Soc Work (14)	1.56	9	3	3.00	5	0		0	N
Gender									
			1.			1.		2.	
			2			5		1	
Female (58)	3.13	4	8	4.31	9	8	5.00	5	2
			1.			1.			
Male (56)	3.16	1	4	4.46	3	5	4.00	1	N
			9			3		A	

Note. These reports are only from those indicating they took practice quizzes in the indicated class offered. Numbers in parentheses represent the number of responses. Four responses in this subset did not indicate academic status. Content areas with less than six responses are not included.

Perceived Advantages of Online Practice Quizzes

Students who reported taking the offered online practice quizzes were also asked if those quizzes helped them learn the material. Of the 114 classes responses, 107 (94%) responded they did and 7 (6%) responded they did not. The reports that quizzes helped students learn the material were consistent, found for every academic status, content area, and gender. See Table 3 for a complete breakdown of these responses.

Table 3: Percent of Responses Indicating Taking Practice Quizzes Helped Them Learn.

	No	Yes
All Responses (114)	6%	94%
Academic Status		
First Year (44)	5%	96%
Second Year (42)	10%	91%
Third Year or above (24)	4%	96%
Content Area		
Acct/Bus/Econ/Org. Leadership (22)	18%	82%
Engineering (30)	3%	97%
Math/Statistics (14)	0%	100%
Anat/Bio/Chem/Earth-Env/Phys (24)	4%	96%
Poly Sci/Psych/Soc/Soc Work (14)	7%	93%
Other (10)	0%	100%
Gender		
Female (58)	9%	91%
Male (56)	4%	96%

Note. These reports are only from those indicating they took practice quizzes in the indicated class offered. Numbers in parentheses represent the number of responses. Four responses in this subset did not indicate academic status. Content areas with zero responses are not included. Percentages may not sum to 100% due to rounding. Content areas with five or less responses are summed together under "Other".

Students who reported taking the offered online practice quizzes were also asked to select why taking these quizzes helped them learn, and they could select any number of options provided. On average, responses indicated the online practice quizzes helped them learn by reviewing or summarizing class material (69%), by helping in test preparation (67%), by helping to distinguish between what they did and did not know (metacognitive awareness) (47%), by providing feedback (43%), by focusing their attention (34%), by reducing anxiety (11%), for other reasons (3%), for unknown reasons (1%), and because they were fun (1%). Some of the "other" reasons given were online practice quizzes were similar to the

in-class quizzes and searching through the text for the online practice quiz prepared the student for searching through the text in open-book exams.

In general, this pattern of responses was found across academic standing, content areas, and gender, though there were some deviations. For example, responses involving the second-year students and those in Account/Business/Economics/Organizational Leadership content area identified test preparation as the most reported reason for online practice quizzes helping them to learn. This suggests the reasons why online practice quizzes help students learn may not be based entirely on the quizzes themselves, but on the personal characteristics of the quiz-takers and the content area. See Table 4 for a further breakdown of these answers.

Table 4: Percent of Responses Indicating Taking Practice Quizzes Helped Them Learn Through a Specific Benefit.

	Review/ Summarize	Test Prep	Meta cognition	Provided Feedback	Helped Me Focus	Reduced Anxiety	Other
All Responses (114)	69%	67%	47%	43%	34%	11%	5%
Academic Status							
First Year (44)	86%	66%	50%	39%	45%	14%	9%
Second Year (42)	55%	71%	38%	43%	21%	10%	0%
Third Year or above (24)	75%	75%	54%	50%	38%	13%	4%
Content Area							
Acct/Bus/Econ/Org. Leadership (22)	41%	73%	32%	27%	18%	5%	0%
Engineering (30)	83%	77%	70%	73%	33%	17%	0%
Math/Statistics (14)	64%	64%	71%	50%	43%	14%	7%
Anat/Bio/Chem/Earth-Env/Phys (24)	75%	63%	38%	42%	46%	17%	8%

Poly Sci/Psych/Soc/Soc Work (14)	71	79%	%	36%	21%	36%	7%	0%
Gender								
Female (58)	64	64%	%	45%	28%	41%	12%	7%
Male (56)	70	75%	%	50%	59%	27%	11%	2%

Note. These reports are only from those indicating they took practice quizzes in the indicated class offered. Numbers in parentheses represent the number of responses. Four responses in this subset did not indicate academic status. Content areas with less than six responses are not included. To conserve space, the "Other" column contains the "Other", "I don't know why" and "Fun" responses.

Dislikes of Online Practice Quizzes

Students who reported taking the offered online practice quizzes were also asked to indicate if there was anything about these quizzes they didn't like by selecting any number of the options provided. The highest number of responses were associated with there being nothing about the online practice quizzes to dislike (47%). However, a smaller number indicated the questions were confusing (14%), there wasn't enough time to answer the questions (13%), the quizzes were boring (6%), the quizzes made them nervous (5%), for "other" reasons (4%), and the online delivery system was confusing (3%). The "other" reasons given for disliking the online practice quizzes were they didn't cover relevant test material (3 responses) and they were too long (2 responses). See Table 5 for a further breakdown of the reasons students disliked the online practice quizzes.

Table 5: Percent of Responders Indicating They Disliked Taking Online Practice Quizzes for a Specific Reason.

	Nothing I didn't Like	Questions confusing	Not enough time	Boring	Mad Me Nervous	Other	Delivery System Confusing
All Responses (114)	47%	14%	13%	6%	5%	4%	3%

Academic Status							
				14			
First Year (44)	41%	14%	9%	%	5%	5%	2%
Second Year (42)	60%	14%	17%	0%	5%	0%	2%
Third Year or above (24)	42%	17%	17%	4%	8%	8%	0%
Content Area							
Acct/Bus/Econ/Org. Leadership (22)	32%	27%	27%	14%	5%	0%	0%
Engineering (30)	47%	17%	0%	3%	7%	3%	0%
Math/Statistics (14)	64%	7%	0%	0%	7%	7%	0%
Anat/Bio/Chem/Earth-Env/Phys (24)	52%	13%	21%	4%	4%	4%	13%
Poly Sci/Psych/Soc/Soc Work (14)	57%	7%	0%	7%	7%	7%	0%
Gender							
Female (58)	40%	12%	17%	3%	3%	5%	3%
Male (56)	54%	16%	9%	9%	7%	4%	2%

Note. These reports are only from those indicating they took practice quizzes in the indicated class offered. Numbers in parentheses represent the number of responses. Four responses in this subset did not indicate academic status. Content areas with less than six responses are not included.

Discussion

A primary focus for this study was to examine student’s self-reported anxiety associated with practice quizzes. The results here are clear, with only 5% of students reporting practice quizzes increased test anxiety. These results are supported by the actual test anxiety scores given for the courses, with average anxiety scores lowest for those classes where students indicated practice exams reduced anxiety and the highest average anxiety scores for those classes where students indicated practice exams increased anxiety.

These results correspond with results of Agarwal et al. (2014), who also report ungraded clicker quizzes resulting in a decrease in anxiety for

middle school and high school students' test anxiety. They also correspond with the results of Khanna (Khanna 2015; Khanna & Cortese, 2016) who found less test-anxiety associated with ungraded, in-class pop-quizzes for college students. As Agarwal et al. commented however, the personal characteristics of those students who reported greater test anxiety from practice quizzes should be examined. Unfortunately, the small number of participants reporting an increase in anxiety because of online quizzes in the current study made such an analysis impossible.

A second focus for this study was to examine the students' perceived advantages to and dislikes of taking those same quizzes. Most students who reported taking the online quizzes also reported those quizzes helped them learn the material (94%), consistent across academic status, content area, and gender. A majority of students indicated the reasons they were considered helpful were because the quizzes reviewed or summarized material (69%) and helped in test preparation (67%). Smaller numbers indicated the quizzes helped to distinguish between what they did and did not know (47%), provided feedback (43%), and focused their attention (34%). There were some minor variations in the prevalence of a particular response for particular courses and academic status, which may reflect differences in the types of material covered in different courses.

In regards to what students disliked about online practice quizzes, the most popular answer was there was nothing about online practice quizzes to dislike (47%). Small percentages of student reports indicated practice quizzes had confusing questions (14%) or there wasn't enough time to answer the questions (13%), with none of the other options selected for more than 10% of the reports. These dislikes may be useful for the designers of online practice quizzes, particularly for providing clear questions with more time allowed for answering, when applicable.

A potential limitation to the current study is different course types are more or less suitable for online practice quizzes. For example, online practice quizzes may not be as appropriate for English classes as for math courses. The representativeness of our sample population of college students could also be a second potential limitation. Our campus is small, with an open-admissions policy, primarily offering a mixture of associate and bachelor degrees. Taken together, these limitations mean any specific differences in online quiz taking between various types of courses may not be reflective of the pattern found within other college populations. More importantly, our data was only collected from participants who chose to

participate in the survey and were already taking the online practice quizzes. Even though our sample suggests most students take these quizzes when offered (84%), these findings may not well represent students who don't participate in surveys or aren't taking practice quizzes. Importantly, however, the current study has demonstrated online practice quizzes are not associated with higher levels of anxiety for the vast majority of college students who are already taking online practice quizzes. For these students, there seem to be many advantages and relatively few disadvantages.

Future experimental research experimentally manipulating the presence/absence of practice tests for those with varying degrees of test anxiety would be a logical next step for validating the potential impact practice tests may have on test anxiety. In addition to being able to help clarify the effect that practice tests have on students not already taking these tests, it would also be helpful to discover why anxiety isn't increased for those who do. For instance, it may be due to increased familiarity with the material and with taking quizzes (as suggested by Agarwal et al., 2014), or the low-stakes nature of practice (e.g. Khanna, 2015) Another important factor to examine may be to determine if different types of test anxiety are impacted differently by online practice tests. For example, those students diagnosed with test anxiety may react differently than those with a more general anxiety caused by lack of preparation.

Based on the current research, we can recommend more classes offer these types of quizzes. At our campus, only a small percentage (24%) of the classes surveyed offered online practice quizzes, but a solid majority of students reported they took advantage of those quizzes (82%). Online practice quizzes, as opposed to the in-class pop quizzes employed by Khanna (Khanna 2015; Khanna & Cortese, 2016), may be easier to include within the class curriculum, as seat-time does not have to be sacrificed. A second recommendation would be for instructors to spend more time explaining to students to use retrieval practice as a study strategy (e.g. Agarwal, et al. 2014). This may not be enough however, as students tend to prefer the simpler strategies even after training (Agarwal, Karpicke, Kang, Roediger, & McDermott, 2008). Hence, we would also suggest students be told their peers report practice tests are beneficial study tools, as they help in learning the material without increasing test anxiety and may in some cases actually reduce it.

In conclusion, the current study provides evidence practice that practice quizzes do not increase test anxiety, but can in some cases cause a

decline. Retrieval practice, which is promoted by these types of quizzes, has been recognized as an effective method of studying for students (e.g. Roediger, et al. 2011), more so than simply re-reading or repeating key facts. While this takes more time for students than the less elaborative strategies, it is typically much more time-efficient (Dunlosky et al., 2013). In addition, the use of online practice quizzes appears to be a type of retrieval practice that most students will use if offered. As retrieval practice is an efficient and effective form of studying, more instructors should consider employing its usage.

Author Contributions

The author made all contributions to the research and the preparation of the manuscript.

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Appendix

1. How old are you?
2. Gender?
3. Have you **completed** more than 30 credit hours of classes? Y/N
4. Have you **completed** more than 60 credit hours of classes? Y/N

We are going to ask the same questions about each of the classes you are taking this semester. If you aren't taking a particular class, leave those questions blank. For instance, most students take four or five classes a semester, so most students will leave questions about their sixth class blank. Make sure to look at the back of the pages too!

If you have filled this survey out in a previous class, please don't fill it out again!

1. For your **FIRST** class, please circle the type of class it is. If you class isn't specifically listed, choose the category it best matches.

<ul style="list-style-type: none"> a. Accounting/Business/Economics /Organizational Leadership/ b. Graphic Design/IT/OIS/Technical Studies c. Agriculture/Food Science d. Art/Cultural/Music/Philosophy/Theatre e. Communication/English/Languages f. Criminal Justice/Law Enforcement 	<ul style="list-style-type: none"> g. Engineering h. Math/Statistics i. Anatomy/Biology/Chemistry/Earth and Environmental Studies/Physics j. Regional Studies/Religion/Anthropology/History k. Political Science Psychology/Sociology/Social Work l. Teacher Education/Early or Middle Childhood
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2. How much time outside of class on average do you spend studying for this class on a weekly basis when there is **not** a test that week? _____Hours _____Minutes
 when there is a test that week? _____Hours _____Minutes
3. On a scale from 1 (no anxiety) to 7 (disabling amount of anxiety), how much anxiety (nervousness or stress) did you experience before a test in this class compared to your other classes?
 1 2 3 4 5 6 7
4. Does this class offer quizzes or tests on Pilot that you can take without potentially losing any points on your final grade? ____Yes ____No
5. If yes, do you take these practice quizzes or exams on Pilot? ____Yes ____No
6. If you take these practice quizzes or exams, do they make you **more or less nervous** for class exams?
 More About the same Less
7. If you take these practice quizzes or exams on Pilot, do they help you learn the material covered by this class? ____Yes ____No
8. If taking these practice quizzes or exams on Pilot helped you learn this course's material, please select any of the following reasons why:

<ul style="list-style-type: none"> a. They review/summarize what we went over in class b. They help me to prepare for what is on the class exams c. They are fun d. They make me less nervous/anxious about the upcoming class exams e. They keep me focused on the material/helped me pay attention 	<ul style="list-style-type: none"> f. They show me the correct answer g. They help me figure out what I know and what I don't know h. I don't know why I think practice quizzes help i. Other (please write why):
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9. Was there anything about the practice quizzes you did not like, even if they helped you learn? If you didn't take practice quizzes in this course, leave these answers blank. Select all answers that apply.

<ul style="list-style-type: none"> a. Pilot, in general, is too confusing b. The questions were confusing c. The quiz didn't give me enough time to answer the questions 	<ul style="list-style-type: none"> d. The practice quizzes made me nervous e. The practice quizzes were boring f. Nothing I didn't like g. Other (please write why):
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10. What strategies do you use for this course when you study outside of class? Select all answers that apply.

<ul style="list-style-type: none"> a. Mnemonics (rhymes, acronyms, memory tricks to help you remember things). b. Repeating key facts/terms over and over c. Using flashcards d. I test myself (not using flashcards) e. Someone else tests me (not using flashcards) 	<ul style="list-style-type: none"> f. Practice quizzes on Pilot, other websites, or from the textbook g. Reviewing materials (guides, class-packets, notes, textbook) h. Re-writing class notes i. Other (please write what other strategies you use):
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