Study on Technology and Learning

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Jeremy Bramwell
University of Central Florida

STUDY ON TECHNOLOGY AND LEARNING

by

JEREMY BRAMWELL

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ABSTRACT

The purpose of this research thesis is to investigate technologies effects on learning. Specifically the researchers studied the usability of intelligent personal assistant-enabled devices for learning assistance. It is assumed that using technology in educational context helps both students and educators because there is a positive effect on engagement which increases learning curves. Although, this is not always the case. The present study yielded results that were not consistent with the assumption that using any type of technology as an aid for learning has a positive effect. Further research will seek to investigate other intelligent personal assistant devices for classroom use.

DEDICATION

This thesis is dedicated to all those that continue to push forward. Never stop pushing.

ACKNOWLEDGMENTS

I would like to acknowledge Dr. Daniel S McConnell and the members in the Technology Aging lab for helping me with the research. I would also like to acknowledge the McNair scholar's family for the support.

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CHAPTER ONE: INTRODUCTION

In this paper, we address the effects of intelligent personal assistant-enabled devices on learning. Educational researchers are studying new teaching methods to aid students to learn better in terms of performance. Learning, as defined by Gross (2012), is the process to acquire new or amend existing knowledge by processing the information on a deeper level. Specifically, learning takes place when the person is able to comprehend the information by manipulating it in different contexts. The information becomes more comprehensible when it becomes easier to apply in different conditions. Vygotsky's sociocultural theory on learning notes that information comprehension is facilitated by engagement with the environment. Piaget theorized that learning is lifelong and dependent on the environment (John-Steiner & Mahn, 1996).

The question posed is, what is technologies role in learning? Some proponents believe technology has a positive effect on education and further advancement of its use will benefit society (Edwards & Cheok, 2018). Current technology designed for educational use is gaining ground in the classroom (Schacter, 1999)- aiding educators by assessing capabilities and difficulties that each student encounters. Educators assign study material with assignments for students to review and then they practice their understanding of the information with the assistance of technology. The educator can monitor students progress and address deficiencies that they might have, which helps with engagement (Goodyear & Retalis, 2010). Companies that have developed these educational tools use a personalized algorithm to create a “brain fingerprint” (Snow, 2019). This shows the students strengths and weaknesses, as well as their progress.

INTELLIGENT PERSONAL ASSISTANT-ENABLED DEVICES

Devices that were designed for daily task assistance are being considered for educational purposes (Nazerian, 2018). Intelligent personal assistant (IPA)-enabled devices have drawn the attention of both researchers and educators. These devices are being investigated for their potential use for teaching and learning (Göksel et al., 2016). IPA-enabled devices can facilitate engagement in the classroom and provide supplemental knowledge in terms of learning a class-related topic (Chou, Chang, & Lin, 2017; Neiffer, 2018).

IPA-enabled devices, such as the Google Home, Amazon Echo, and Apple HomePod, assist with gathering information as well as providing the sources the data was retrieved from (Google Home, 2016). The devices also respond to different chat-based queries by using language algorithms to pick up on the syntax of the user command by categorizing it using a dialogue knowledge base (Kepuska & Bohouta, 2018). The natural language asset makes the devices engaging to learners when studying a subject (John-Steiner & Mahn, 1996).

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

The devices have Artificial Intelligent software loaded on them, such as the Google Assistant, Amazon's Alexa, and Apple's Siri, respectively. This software assists people with an assortment of tasks from basic ones such as solving a simple mathematical problem to complex tasks such as searching for information (Sejnoha, 2013). Artificial intelligence is the phenomenon of machines comprehending commands and performing tasks independently (Nilsson, 1998). Researchers that study artificial intelligence define it as machines making independent decisions to perform different functions efficiently.

The IPA-enabled devices process complex commands through machine learning, which, in this case, is the process that artificially intelligent systems use to adapt to user commands.

This method of using algorithms and statistical analyses lets the device autonomously develop its system structure to the user's preference (Bishop, 2006). Machine learning uses unique algorithms to analyze data then make necessary adjustments for efficient processing (Beal, n.d.).

TECHNOLOGY ENHANCED LEARNING AND INTELLIGENT PERSONAL ASSISTANTS

Technology Enhanced Learning (TEL) is the application of novel technology to instruction methods that will boost learning performance (Goodyear & Retalis, 2010). Educational technology amplifies student confidence which in turn leads to increased classroom engagement, information retention, and test performance (Lynch, 2017). Schacter (1999) states that there is a general assumption that technology is beneficial for learning and student achievement because an analysis of the studies on educational technology has shown satisfactory results.

As mentioned before, learning is the process of acquiring and understanding information. To disseminate data in the world, different levels of information processing take place in the brain. Deciphering or modifying preexisting information is not a simple task. Albeit, metacognition, which is the self-awareness about one's own cognitive processes helps facilitate learning (Biggs & Moore, 1993). Researchers have pointed out that interactive technology can help process information in the style preferred by the learner (Gordon, 1996). Constructing knowledge about a subject is like creating a mental model of it. People gather information from the environment (or sources of information e.g., databases) so it can be cognitively processed. Technology can facilitate gathering information for efficient mental model creation.

IPA-enabled devices such as the Google Home have features that are viable for learning and studying assistance. Some devices already have features for classroom education use, such as the Amazon Alexa's learning application (Herold, 2018). IPAs make it efficient to obtain

information from databases (Beal, n.d.), then verbalize the information to the user (Kumar et al., 2017). This search and response feature that the devices possess is a likely deterrent for people to search for information through traditional methods (Winkler, 2018). Asking questions to the devices helps with remembering the original question, opposed to searching through an encyclopedia (Machajewski, 2018). The devices are also facile, mobile, and can access a vast knowledge bank with just a command. Amazon has already deployed a strategy to make the Alexa the main medium to access information (Machajewski, 2018).

Other features are noted for the device's benefits to students such as organizing tasks and accessing databases to gather information (Machajewski, 2018). Users can use the devices to set up and then remind them about tasks that need to be done in addition to accessing information using voice commands (Göksel, 2016; Sejnoha, 2013). The research that has investigated IPA and their enabled devices is not expansive but, there exists some data to assist in guiding the understanding of these devices' usability in learning.

There have been some devices that have failed in their implementation for learning assistance. These devices are interface agents, which are like intelligent agents in that they both use artificial intelligent techniques to assist users. The only difference is that the interface agents interact with users for a designated platform (McCabe, 1994). Some agents developed to assist users to learn how to perform different tasks have been discontinued because of their failed implementation. Examples of the ones that have been discontinued are Microsoft Agent, Microsoft Bob, Ms. Dewey, Office Assistant, and others. Swartz (2003) notes that there is not enough research on the reason devices developed to assist users by teaching, tips, and guidance in their implemented areas. There are some possible theories like bad appearance, quirky

interfaces, failed expectations, and perception of reduced control and self-reliance (Swartz, 2003). Thus, research is essential to evaluate intelligent agents in different contexts.

CHAPTER TWO: BACKGROUND

A case study on IPA-enabled devices and language development showed that these devices could assist with second language-learning acquisition for non-English speaking users (Dizon, 2017). The results showed that use of the IPA-enabled devices, specifically Amazon Alexa, did not improve learning efficiency because of the inability to understand second language English utterances from the participants. However, learning effectiveness increased due to the pronunciation feedback provided by Alexa (Dizon, 2017). Amazon Alexa can provide better access to conversational opportunities for students when it comes to learning a second language (Nazerian, 2018). Research that has studied IPA-enabled devices for their potential use in education have noted that they are beneficial for second language learning (Göksel, 2016).

A study investigating the effects that IPA-enabled devices have on classroom engagement found no significant differences after they were implemented (Neiffer, 2018). There were also no significant results for the amount of times the device was used in different situations amongst different students (Neiffer, 2018). There are mixed results about technology being beneficial for educational achievement (Calkins & Bowles-Terry, 2013) as well as student engagement (Donovan et al., 2010). Proponents have stated that the devices are fun and engaging the classroom (Herold, 2018), but not enough studies have investigated this assumption.

Development of a different iteration of a virtual assistant is underway in the context for learning. Researchers have taken the systemic models of intelligent personal assistants to construct a personal assistant for learning (PAL). A PAL is a device that makes recommendations and monitors the user's activities in real time (Raybourn et al., 2015). PAL uses persistent user models to assist in developing a user's knowledge and abilities in methods that are created specifically for them. A persistent user model is a data structure that keeps the

original version of itself while creating new updated versions (Driscoll, 1989). It is essential to investigate IPA-enabled devices to further the development of technology that can be used in learning, like the PAL, and create models for the development.

Fleming (2014) notes the benefits that IPA-enabled devices have for educators and students, such as organizing their work, taking notes, and assisting with assignments by providing information about topics. The devices could also incorporate more features to assist with other tasks for students. Teachers are already using the device to assist them in the classroom. Herold (2018) has students use devices to engage the classroom in activities that tested their knowledge. Other reported its use in classrooms for converting units of measure, providing a timer for group activities, defining terms, and playing audio books (Machajewski, 2018).

Fleming (2014) notes that the IPA, Cortona, should be developed to be compatible with learning management student management, and lecture capture systems. These developments could bring a positive impact for education in terms of organization and management. Utilizing note taking and lecture capture together could make teaching and learning systems more efficient as well.

The goal of the present research study is to measure whether intelligent personal assistant-enabled devices promote learning in terms of performance. In this study, the traditional method of studying, which is reading a chapter from a textbook (studying a passage), will be tested against using the Google Home.

HYPOTHESES

The following hypotheses were generated for this study:

Hypothesis 1: Based on the literature review regarding the features that IPA-enabled devices possess, we predict that participants using the Google Home will achieve higher scores than participants that studying the passage.

Hypothesis 2: Based on the review of the literature on how technology can be useful for learning, we predict that participants using the Google Home will be more confident than the participants in the literature condition to take the test.

Hypothesis 3: Based on the outcome of the second hypothesis as well as the literature on metacognitive accuracy, we predict that both conditions will accurately predict their scores after taking the test.

Hypothesis 4: Based on the review of the literature about technologies impact on learning outcomes, we predict that participants using the Google Home will rate the device as being helpful for studying.

Hypothesis 5: Based on the review of past studies that investigated engagement with IPAs in an educational setting, we predict that participants using the Google Home will report having a low level of engagement with the device.

Hypothesis 6: We predict that there would be a correlation between the number of queries to the Google Home and test scores.

CHAPTER 3: METHODOLOGY

PARTICIPANTS

Twenty-two undergraduate students were recruited. Fifty-five percent of the sample was male, while 46% was female. Fifty-two percent of the total amount of participants identified as being white, 22% of them Black or African-American, 8% of them Asian, and the remaining 20% was mixed/other. Thirty-two percent of the total amount of participants owned an IPA-enabled device such the Google Home, Echo Dot, etc., but only 18% of the participants used it daily to assist with tasks. One participant stated that he was a non-native speaker of English. No subjects reported familiarity with the subject matter involved in the research.

TABLE 1 DEMOGRAPHIC CHARACTERISTICS, CROSS-VALIDATION SAMPLE

Ethnicity	**Male**	**Female**	**Totals**
Black or African American	0	3	3 (13.64%)
White	7	3	10 (45.45%)
Asian	1	0	1 (4.54%)
Hispanic/Latino	0	1	1 (4.54%)
Other	4	3	7 (3.18%)
Total	**12 (54.54%)**	**10 (45.45%)**	**22**

DESIGN

This study employed a between-subjects design with two study method conditions that had 11 participants in each. The two conditions were either: the Google Home device (technology condition) or reading the textbook (literature condition). The subject matter that the participants studied was Human Geography. Half the participants were randomly assigned to study for the test using the Google Home, and the other half read the textbook.

MATERIALS

Google Home. The Google Home is a voice-activated smart speaker (Google Assistant) and was connected to the internet via Wi-Fi. With access to the different databases and the internet, the Google Home responded to search requests from the user, verbalizing the information through the speaker system.

RCA7 tablet. The RCA7 tablet was connected wirelessly to the Google Home. The tablet collects recent commands, responses and the sources that they were derived from the device and displays it so that the user can keep track of recent search inquiries, sources of information, and other queries. The tablet was meant to help the participants keep track of the information that the Google Home was presenting them.

Advanced Placement Human Geography. The book preps high school students for a placement exam with college-level material. The level of difficulty was optimal for undergraduate participants. The questions derived from this book were used to assess the knowledge of the participants on a specific topic that is related to Human Geography. Eleven questions were taken from the textbook and four others came from the website for additional practice.

The questions from the chapter were assessed before experimental testing to see if the information was available on the internet. This was to ensure that when participants searched for the information using Google Home, that there would be positive search results. Questions that were used to assess the participant's knowledge can be found in the Appendix Section E. Participants in the literature condition had to read the Economic Geography section for the test.

Study Guides. A study guide was provided as an aid for looking up specific information that would later appear in the assessment. The purpose of the study guide was to assist the students in looking for the information pertinent to what would be on the test in the allotted time

given to study. The information that the participants had to study can be found in Appendix Section D.

OUTCOME MEASURES

Demographic scale. A questionnaire on the participant's background was administered to collect demographic data. The background information gathered inquired about participant's sex, race, ownership of an IPA-enabled device, and familiarity with using an IPA. Questions that participants had to fill out for this study can be found in Appendix Section A.

System Usability Scale. Brooke's (1986) system usability scale was used to measure the perceived usability of the Google Home device. Participants in the Google Home condition rated their experience with the device using the scale. The scale measures the person's rating of the effectiveness, efficiency, and satisfaction with the device. The scale and the questions asked in the study can be found in Appendix Section B. The scale's reliability was reported to be high with a Cronbach's alpha of 0.91. The frequency of its administration was analyzed over 200 studies and a mean SUS rating of 70.14 was reported to be the standard usability cutoff score. Devices that score a 75 in usability are placed in the upper 50^{th} percentile of the total devices analyzed in usability studies (Bangor, 2008).

Networked Minds Social Presence Inventory. This study utilized Biocca and Harm's (2003) Networked minds social (NMS) presence inventory to investigate participant's perceived state of social presence with the Google intelligent assistant. The scale measured participant's perceived level of co-presence and social presence as well as assesses the subjective and intersubjective symmetry (the degree to which the user thinks the device shares the same state of social presence). The subscales of the NMS scale evaluated the different aspects of social presence between users and other social mediums. Co-presence measured the degree the user

reported sharing a common environment and sensory awareness with the device. Attentional engagement measured the reported degree of mutual attention between the user and the device. Behavioral interdependence measured the reported degree of dependent action between the user and device. Perceived comprehension measured the reported degree of mutual understanding between the user and the device.

Some questions were removed from the inventory to deter participants from confusion and inaccurately answering the entire questionnaire. The questions that were either used or removed are noted in Section F of the Appendix. Different Cronbach alphas were reported for each subscale and all of them were greater than .80. Specifically, the Cronbach's alpha was reported as .83 for copresence, .81 for attentional allocation, .87 of perceived message understanding, and .82 of perceived behavioral interdependence.

Perception of Preparedness scale. Participants in both conditions had to state their level of preparedness for the exam and their level of confidence after taking the exam. The scales were on a 0-10 Likert scale with one being "Extremely," three being "very well," five being "moderately well," seven being "slightly well," and nine being "not well at all." The scale and the questions asked before and after the test can be found in Appendix Section G.

PROCEDURES

Participants in the Google Home condition received training to learn how to use the device as well as the RCA7 tablet. Participants in the traditional method only received instructions to study the Economic Geography section in the textbook. The participants were told not to use any devices, writing utensils, or notes to study. Participants in both groups were given 30 minutes to review the material using the assigned learning method. After, they rated their level of preparedness to take the assessment on the material they studied using a Likert scale,

then took a ten-minute break. Participants were instructed not to leave the lab or attempt to cheat by using any device to search for information related to what was on the study guide. One participant, however, did use the restroom during the ten-minute break. The participants then took a 15-item multiple choice exam that assessed their proficiency on the material for no more than 30 minutes. After the assessment, the participants rated their confidence in performance on the exam using a Likert scale without being told their scores. Participants in the Google Home condition also had to complete system usability scale and networked minds social presence inventory survey after the assessment.

CHAPTER 4: RESULTS

TEST RESULTS

We believed that participants in the Google Home condition would perform better in terms of learning than participants that read the literature. The tests were scored for the number of correct responses out of 15, which is the total amount of questions on the test. An independent sample t-test was used to compare the means of the two conditions. The results indicated that those in the literature condition (M = 9.55, SD = 1.57) scored higher on the test than those in the Google Home condition (M = 6.46, SD = 2.30), t (20) = 3.68, p<.001. Thus, the hypothesis was not supported in this case.

CONFIDENCE AND PREDICTION SCALE

We predicted that participants using the Google Home would be as confident as the participants in the literature condition to take the test. We also believed that the level of confidence would be reflected in predicting their scores after the test. An independent samples t-test was used to analyze the level of confidence before the test between the participants in the literature condition (M = 5.55, SD = 1.81) and the Google Home condition (M = 6.36, SD = 2.65). The results showed that the participants in the Google Home condition were more confident to take the test than the participants in the literature condition t (20) = -0.84, p< .41.

We took the participant's test scores and predicted scores then converted them into percentages. We then subtracted them and ran the same analysis we used to analyze the level of confidence. The results showed that participants in the literature condition (M = -0.04, SD = 0.18) were more accurate at predicting their scores than those in the Google Home condition (M

= 0.25, *SD* = 0.27). The second hypothesis was supported in this context but not the third, *t* (20) = -2.93, *p*< .008.

SYSTEM USABILITY SCALE

We predicted that participants using the Google Home would rate the device as being usable for studying. The system usability scale was administered to the participants to measure their subjective perceptions of the device for studying. The average rating of the device (*M* = 36.64, *SD* = 6.38) was below average (Sauro, 2011), indicating that participants did not perceive the device as usable for studying. Thus, the fourth hypothesis was not supported in this context.

We also analyzed the data to see if there was any correlation between engagement and usability. There was also a non-significant relationship between the scores on the System Usability Scale and test scores (*r* (20) =-0.04, *n.s.*).

NETWORKED MINDS SCALE

We believed that participants using the Google Home would not fully engage with the device as if it was natural to communicate with it socially. We analyzed the participant's perception of the Google Home as being socially interactive using the NMS inventory scale. Participants reported having a higher level of behavioral interdependence (*M* = 4.25, *SD* = 1.63) with the Google Home than level of co-presence (*M* = 3.88, *SD* = 1.53). Their level of behavioral interdependence with the device was also higher than their perception of attentional engagement (*M* = 3.84, *SD* = 1.76) but, was the same as their perceived comprehension (*M* = 4.25, *SD* = 1.68). Overall, there was no correlation between participants' perception of themselves and the Google Assistant (*r* (0, 20) = -.097, *n.s.* Thus, the hypothesis was not supported in this case.

TEST SCORES AND QUERIES

TABLE 2. QUERIES, ERRORS, AND GRADES

	M	SD
Number of queries	34.91	22.92
Error responses	11.55	8.00
Test Grades	6.45	2.30

We predicted that the test scores would correlate with the number of queries asked to the Google Home. We conducted a correlational analysis between the two variables and found that there was no correlation between them (r (11) = 0.16, *n.s.*) We then examined if there was a correlation between the number of error responses that the Google Home gave and participants' test scores. Again, there was no correlation between the two variables (r (11) =-0.15, *n.s.*). On average participants were asking 35 questions to the Google Home while getting about 12 error responses per session. Table 2 contains the average number and standard deviation of the number of queries and error responses for each participant in the Google Home condition.

CHAPTER 5: DISCUSSION

This research thesis investigated the effects technology has on learning. Specifically, we conducted a usability study on the Google Home device as a method of studying. The study compared usability of an artificially intelligent device as a tool for studying to orthodox methods. Participants' comprehension of the material was used to compare the methods of studying to each other. The intelligent personal assistant-enabled device was used because of its software, features, and components that seem useful for studying assistance (Machajewski, 2018). However, the results of the study show that Google Home did not assist participants to learn better, in terms of performance, then participants that read the text. The probable explanation for this result could be that the Google Home device is not a tool devised for studying purposes (Nazerian, 2018). Developers that make and maintain Intelligent personal assistant enabled devices structure them to assist with tasks and not strictly for learning purposes.

Coincidentally, although the participants using the Google Home did not perform better in terms of learning, they were more confident than those that read the text to take the test. This confidence could be due to the general assumption that technology benefits learning in terms of performance (Schacter, 1999). Perhaps the blind faith the participants had was strong enough to affect their confidence for the test. As beneficial as it could be for test preparation, this amount of confidence did not assist the participants to perform well on the test in actuality. Both conditions reported confidence levels relate to their predicted scores as well. Participants in the Google Home condition predicted they performed better than they actually did, while the participants in the literature condition were almost accurate in their predictions. Perhaps the misconception of reliability carried over after the test, causing the participants to inaccurately predict their scores. Additionally, the predicted scores in the literature condition align with

current study's findings on reading comprehension and metacognitive accuracy (Soto, et al., 2019). People that understand the reading content are almost accurate at predicting their test achievement scores.

Additionally, the overall usability score of the device was compared to the average usability score across 206 different studies (Sauro, 2011). Results show that participants in the Google Home Condition did not perceive the device to be usable for studying. Schacter elaborates that technology that is developed in the shadow of learning theories have a higher potential of assisting with learning than any other device (Schacter, 1999). Moreover, users probably felt mislead by the reliability of the device which heightened their dissatisfaction with it. So, perhaps anthropomorphic dissonance influenced the user's perception of the device (Watt, 1998). Anthropomorphic dissonance is the lack of harmony between a device that has human like features and its perceived use.

Anthropomorphic dissonance also might explain the results for participants level of social engagement with the device. Participants did not perceive the Google Home as being socially interactive as shown by the results. These results are with the device were also consistent with Neiffer's (2018) study that devices that seem like they can facilitate engagement do not always do so. Perhaps the user's perception that the device will facilitate learning a new topic was lowered due to the error and lagged responses. Specifically, participants thought the device was not functioning properly which lowered their perceived level of social interaction. This could potentially be the reason why participants in the Google Home condition did not do as well as the participants in the literature condition. Vygotsky's theory of development elaborates on the importance of an engaging stimulus or environment benefiting learning (John-Steiner & Mahn, 1996).

Finally, our findings did not support our fifth hypothesis that participant's test scores would correlate with the number of queries made. Further data analysis also showed that participants that were affected by the network issues did not have significantly different scores from participants that were not affected. These results could be explained by participants level of information processing when interacting with the device. Perhaps the participants' were attempting to memorize the information given by the Google Home but were unable to hold it all. Miller's (1956) principle for memory consolidation can be applied here in that people can only contain so much information at a time. Individual differences in memory capacity also could be the reason some participants in the condition did better than others.

This study aids our understanding of the usability of intelligent devices in learning and technology's role in education. Future research should investigate the usability of other intelligent devices in educational settings. Development of digital assistants is increasing exponentially, and their applications can be investigated in different contexts. Hopefully, future studies can use the information this study reported on IPA-enabled devices effects on learning.

The limitations that were encountered in this study was the change in design which, subsequently, reduced the sample size. The research design was previously a two-part session which also included a separate subject matter for the Google Home condition. Also, the spotty wireless internet connection with the device did affect the user's interaction. Another tip is to address that IPA-enabled devices operate independently of a tablet. Many IPA functions and components (e.g. applications) coincide with the use of a tablet. Therefore, when investigating IPA-enabled devices, consider if additional devices are necessary or not. Future research should accommodate the recruitment time frame for volunteers and test the internet connection before initiating the study.

APPENDIX A: DEMOGRAPHICS QUESTIONNAIRE

1. What is your age?

2. What is the highest level of school you have completed or the highest degree you obtained?
   - Less than high school degree
   - High school graduate (high school diploma or equivalent including GED)
   - Some college but no degree
   - Associate degree in college (2-year)
   - Bachelor's degree in college (4-year)
   - Master's degree
   - Doctoral degree
   - Professional degree (JD, MD)

3. What is your major?
   - Arts & Humanities
   - Burnett Honors College
   - Business Administration
   - Community Innovation and Education
   - Engineering & Computer Science
   - Graduate Studies
   - Health Professions and Sciences
   - Medicine
   - Nursing
   - Optics & Photonics
   - Rosen College of Hospitality Management
   - Sciences
   - Undergraduate Studies

4. What is your current employment status?
   - Working (paid employee)
   - Working (self-employed)
   - Not working (temporary layoff from a job)
   - Not working (looking for work)
   - Not working (retired)
   - Not working (disabled)
   - Not working (other)
   - Prefer not to answer

5. Choose one or more races that you consider yourself to be:
   - White
   - Asian
   - Black or African American
   - Native Hawaiian or Pacific Islander
   - American Indian or Alaska Native
   - Other

6. What is your sex?

- Male
- Female
- Other

7. On average, how many hours do you study per week?

8. Do you OWN a smart speaker device (e.g., Google Home, Echo Dot, etc.)?
   - Yes
   - No
   - I'm not sure

9. Do you USE a smart speaker device (e.g., Google Home, Echo Dot, etc.)?
   - Yes
   - No
   - I'm not sure

10. Do you USE an Intelligent Personal Assistant-enabled device or Virtual Personal Assistant-enabled device (e.g., Siri, Google Assistant, Microsoft Cortana, etc.)?
    - Yes
    - No
    - I'm not sure

11. What is the language you are most comfortable speaking?
    - English
    - French
    - Indian Languages (Hindi, Bengali, etc)
    - Mandarin
    - Russian
    - Other Please specify):

12. Are you an international student?
    - Yes
    - No

APPENDIX B: SYSTEM USABILITY SCALE

	Strongly disagree				Strongly agree
1. I think that I would like to use the Google Home frequently	1	2	3	4	5
2. I found the Google Home unnecessarily complex	1	2	3	4	5
3. I thought the Google Home was easy to use	1	2	3	4	5
4. I think that I would need the support of a technical person to be able to use the Google Home	1	2	3	4	5
5. I found the various functions in the Google Home were well integrated	1	2	3	4	5
6. I thought there was too much inconsistency in the Google Home	1	2	3	4	5
7. I would imagine that most people would learn to use the Google Home very quickly	1	2	3	4	5
8. I found the Google Home very cumbersome to use	1	2	3	4	5
9. I felt very confident using the Google Home	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with the Google Home	1	2	3	4	5

APPENDIX C: HUMAN GEOGRAPHY STUDY GUIDE

Study Guide

A.1

Understand the following concepts:

- Stage of production concerned with finance and banking
- Functioning of fifth world countries
- Development of Old Asian tiger countries
- Aspects of tertiary production
- Connection between producers and consumers in producing and distributing goods
- Problems with the terms: First world, second world, third world countries
- Rostow's theory of stages of growth
- The connection between Software development, customer-service call centers, and corporate headquarters
- The modern service economy
- Gross Domestic Product and Gross National Income
- Complaints about First-world transnational corporations
- Economic Sectors
- Employee conditions in tea producing companies
- Manufactured goods such as farm products and natural resources
- Natural resources

APPENDIX D: HUMAN GEOGRAPHY TEST

1. Which stage of production is concerned with activities such as finance and banking
   A. Primary
   B. Secondary
   C. Tertiary
   D. None of the above
   Answer: D

2. Fifth world countries_____
   A. Lack a functioning economy and have no formal national government
   B. Are industrialized and have service-based economies
   C. Have experienced an economic crisis that has immobilized the national economy
   D. Subjugate and dominate natives of conquered lands and convert them to Christianity
   Answer: A

3. The source of development funding for Old Asian Tiger countries comes from what?
   A. The Reagan plan
   B. The Clinton reform for international funding
   C. The Bush stimulus package
   D. The Macarthur plan
   Answer: D
4. Which of the following includes only aspects of tertiary production?
   A. Finance, mining, transportation
   B. Transportation, wholesaling, retailing
   C. Forestry, processing, fabrication
   D. Finance, wholesaling, fabrication
   Answer: B

5. The links between producers and consumers in the production and distribution of goods are known as
   A. Value-added processing
   B. Sustainable economics
   C. Commodity chains
   D. Goods and Services
   Answer: C

6. One of the problems with using the terms first world, second world, and third world to describe countries is that
   A. First-world countries are sometimes lacking free markets and a high level of productivity value per person
   B. The terms are slightly misleading, since second world countries are not necessarily between first- and third-world countries, but instead are communist centrally planned economics
   C. Third-world countries have agricultural or resourced-based economics but a high quality of life
   D. Second-world countries are sometimes lacking controlled markets systems and a mediocre level of productivity value per person

Answer: B

7. Rostow's theory of stages of growth fails to take into account all of the following except
   A. A set of preconditions needed to transition from an agricultural to a manufacturing economy
   B. The historical patterns of non-industrialized countries
   C. Industrialized nations forcible extraction of valuable natural resources in the third world
   D. Bringing forms of religious toleration and absolute rule to England
   Answer: A

8. Software development, customer-service call centers, and corporate headquarters are all examples of
   A. Activities that aren't tied to any specific location
   B. Outsourced services
   C. Weight-losing manufacturing
   D. Activities that are tied to any specific location
   Answer: A

9. Which of the following best defines the modern service economy?
   A. The creation of both durable and non-durable goods
   B. A labor force composed of hourly employees who receive few benefits
   C. A labor force composed of salaried employees who receive many benefits
   D. A labor force composed of volunteer employees who receive no benefits
   Answer: A

10. The difference between GDP and GNI is
    A. GDP considers goods and services, but GNI also considers imports and exports
    B. GDP measures collective wealth or productivity, but GNI measures general well-being
    C. All of the above
    D. None of the above
    Answer: A

11. All of the following are complaints about first-world transnational corporations except
    A. Their desire to invest in modern technological equipment and worker training
    B. Their tendency to create economic dependency of LDCs on MDCs
    C. Their postcolonial exploitation of the populations of LDCs for lower wages
    D. None of the above
    Answer: A

12. A sector is
    A. the way the economy is submerged into different categories
    B. the type of products or services that are created
    C. the processing of raw materials
    D. the way the economy is divided into different categories

Answer: D

13. Most people who work for tea producing companies live in good conditions
    A. True
    B. False
    Answer: B

14. Manufactured goods are farm products and natural resources that
    A. contributes to global warming
    B. go through resource processing
    C. have been taken through value-added processing
    D. create refineries for goods
    Answer: C

15. Natural resources can be_____
    A. attributed to high benefit services
    B. reused for an indefinite period
    C. contemporary on availability
    D. divided into two pairs of linked sectors based on their renewability and prices
    Answer: D

APPENDIX E: NETWORKED MINDS SOCIAL PRESENCE INVENTORY

When answering the following questions, please refer to the interaction you had with the Google Home.

1. I often felt as if the Google Home assistant and I were in the same room together.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

2. I was often aware of the Google Home in the room.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

3. I hardly noticed the Google Home in the room.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

4. I often felt as if the Google Home and I were in different places rather than together in the same room.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

5. The Google Home was often aware of me in the room.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

6. The Google Home didn't notice me in the room.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

7. I paid close attention to the Google Home.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

8. I was easily distracted from the Google Home when other things were going on.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

9. I tended to ignore the Google Home.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

10. The Google Home paid close attention to me.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

11. The Google Home tended to ignore me.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

12. I was able to communicate my intentions clearly to the Google Home.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

13. My thoughts were clear to the Google Home.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

14. I was able to understand what the Google Home meant.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

15. The Google Home was able to understand what I meant.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

16. My actions were often dependent on the Google Home's actions.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree

○	○	○	○	○	○	○

17. My behavior was often in direct response to the Google Home's behavior.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

18. What I did often affected what the Google Home did.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

19. The Google Home's actions were often dependent on my actions.

Strongly Disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
○	○	○	○	○	○	○

Questions not used in inventory:

- The behavior of the Google Home was often in direct response to my behavior.
- When I was feeling nervous, the Google Home also seemed to be nervous
- The Google Home was easily distracted from me when other things were going on
- I think the Google Home often felt as if were in the same room together
- I think the Google Home Often felt as if were in different places rather than together in the same room
- I was sometimes influenced by the Google Home's moods.
- When I was happy, the Google Home tended to be happy.
- When I was feeling sad, the Google Home also seemed to be down.
- The Google Home Was sometimes influenced by my moods.
- When the Google Home was happy, I tended to be happy.
- When the Google Home Was feeling sad, I tended to be sad
- When the Google Home was Nervous, I tended to be nervous.
- The Google Home was able to communicate their intentions.
- The Google Home's thoughts were clear to me.

APPENDIX F: PRETEST AND POSTEST METACOGNITIVE SCALE

On a scale of 1 to 10, how well do you think you did on the test?

On a scale of 1 to 10, how well do you think you are prepared for the test?

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