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Examining Learning Styles and Perceived Benefits of Analogical Problem Construction on SQL Knowledge Acquisition

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ABSTRACT

The demand for Information Systems (IS) graduates with expertise in Structured Query Language (SQL) and database management is vast and projected to increase as 'big data' becomes ubiquitous. To prepare students to solve complex problems in a data-driven world, educators must explore instructional strategies to help link prior knowledge to new knowledge. This study examined learning styles and the perceived benefits of analogical problem construction on SQL knowledge acquisition. The data collected from 80 participants suggests there is a perceived positive benefit to using analogical problem construction for learning introductory database concepts. The learning style of the majority of students in the sample is 'Active-Sensing-Visual-Sequential.' However, learning styles were not related to student perceived impact of analogical problem construction to understand database concepts. Student analogies were collected for a variety of SQL concepts; noteworthy examples are highlighted. While results related to learning styles are intriguing, the most promising path for further exploration (for both research and practice) is the use of analogy problem construction in Information Systems educational environments.

Keywords: Structured Query Language, Analogy learning, Learning styles, Knowledge transfer, Analogical reasoning

1. INTRODUCTION

Recent studies have highlighted the importance of improving education for a new generation of students in data-driven information systems (IS) educational areas (Chen, Chiang, and Storey, 2012; Chiang, Goes, and Stohr, 2012). Among courses offered by IS faculty, database management is the most consistently offered course among the IS 2010 curriculum model (IS 2010.2) with approximately 97% of programs including this class (Bell, Mills, and Fadel, 2013). Demand for graduates with expertise in Structured Query Language (SQL) and database management remains strong. The growth of SQL is often attributed to its role as a standard data access method for big data (Soat, 2014). Both Computer Weekly and ZDNet find SQL as the software skill most in demand (Flinders, 2011; Lomas, 2011). Student's graduating with a background in database often find themselves in a unique situation when interviewing for a professional IS position. Many interviews not only require students to be proficient in database nomenclature, but are often required to write structured query language code to solve business problems as part of the interview (Kadlec, 2008).

Many professors have recognized the importance of writing code by organizing coding labs for applied practice. Unfortunately, database education often includes lectures and slides with lots of terminology as the only instructional approach to transfer this knowledge to the learner. As a result, students are unprepared to solve complex problems in industry including the rigorous interviewing process (Schank, 2002; Tang, Lee, and Koh, 2000).

Strategically bridging new information to an individual's prior knowledge is documented in the literature as a way to improve the learning process (Catrambone and Holyoak, 1989; Gentner and Holyoak, 1997). Analogy problem construction represents an instructional strategy used to link prior knowledge to new knowledge (Togo, 2002). Analogy problem construction involves students creating their own analogous problems to better understand and retain new knowledge (Bernardo, 2001). The focus of this technique is to tap into a learner's existing knowledge structures and leverage this prior knowledge to new knowledge. The use of analogies in learning are credited as among the most effective method of solidifying abstract concepts to better understanding and retention of new knowledge (Dincer, 2011). As a result, linking new knowledge to personal knowledge contribute to meaningful, active, and effective learning (Seyihoglu and Ozgurbuz, 2015).

Prior research also suggests learning styles potentially have an impact on user learning (Bostrom, Olfman, and Sein, 1990). The Felder and Soloman Index of Learning Styles instrument was specifically created to identify learning styles in a classroom setting (De Vita, 2001). The instrument organizes competing learning styles, which include active versus reflective, sensing versus intuitive, visual versus verbal, and sequential versus global preferences. Felder (1993) argues sound instruction should incorporate a variety of teaching styles addressing each side of the learning dimensions at least part of the time.

Although research related to analogy problem construction and learning styles are examined in some detail (Cellucci et al., 2011; Togo, 2002; Zheng et al., 2008), there is a dearth of research in information systems education (Cegielski, Hazen, and Rainer, 2011). Felder and Silverman (1988) argue students absorb concepts more quickly when instructional strategies are consistent with the student's learning style. A recent information systems study supports the value of matching activities with learning styles when possible. The study examined learning styles and object-oriented computer programming and found performance increases when the instructional strategies closely matched the student's learning style (Cegielski, Hazen, and Rainer, 2011). The authors conclude the research "serve[s] as a foundation from which to launch a detailed research agenda in the area of learning styles within the IS educational domain" (Cegielski, Hazen, and Rainer, 2011, p. 144).

Many important questions remain unanswered in the IS educational domain. Given Dincer's finding that analogy problem construction is potentially the most effective method of linking new concepts to prior knowledge (Dincer, 2011), we examine the method within an information systems context. Specifically, our study investigates the use of analogy as a possible tool to improve the efficiency and effectiveness of learning new information systems topics, such as SQL, subject to students' learning style.

In light of the above, we questioned how do IS students perceive learning activities that may be inconsistent with his or her preferred learning style? Does analogy problem construction provide a beneficial link to prior knowledge when learning structured query language (SQL) concepts? To address these questions, this paper addresses the following four research questions:

Research Question 1: What will students' perceptions be regarding the use of analogy problem construction to learn introductory database (SQL) concepts?

Research Question 2: What are the learning styles of students in introductory database courses based on the Felder-Soloman's Inventory of Learning Styles (ILS)?

Research Question 3: How will students' perceived benefits of using analogical problem construction to learn introductory database (SQL) concepts be impacted by their specific learning style using the Felder-Soloman's Inventory of Learning Styles (ILS)?

Research Question 4: Do student examples of analogical problem construction related to SQL concepts in an introductory database course illustrate creativity and personal links to prior knowledge?

2. BACKGROUND AND LITERATURE REVIEW

2.1 Analogical Problem Construction

Analogical learning is a process where two different information components are compared to provide a better understanding of one of the information components (Gentner, Lowenstein, and Thompson, 2003). A simple example in the database field is that a database index is like a card catalog in a library. The base is the set of information focused on for deeper learning, while the other set of information serves as the analog (Houde, 2007). In the example, the database index is the base while the card catalog is the analog. Anagogical problem construction involves allowing students the opportunity to construct their own analogous problems to better understand the underlying knowledge and add their own experiences to the solutions (Bernardo, 2001). Prior research on analogical learning generally indicates that this learning activity provides additional cues allowing for better analogical transfer, even when the knowledge transfer assessment was delayed (Catrambone and Holyoak, 1989; Genter and Holyoak, 1997). One potential for the improved knowledge transfer related to analogical problem construction tasks is the opportunity to connect new knowledge directly to an individual's past experiences and existing knowledge structures (Cummins, 1992).

Prior research suggests an individual's schema can be used to facilitate association between new and prior knowledge (Cosgrove, 1995). Schema theory posits knowledge is organized and classified and represented in symbolic organizing structure (Zheng et al., 2008). Research also shows analogical problem construction is beneficial for developing more advanced schemas (Bernardo, 2001; Cummins, 1992; Novick and Holyoak, 1991). For instance, Bernardo (2001) had students tap into their existing schema structures by creating their own analogical problem constructions to learn mathematical problem solving in basic probability. Results suggest analogical problem construction created an improved grasp of the concepts being learned, in part, because of the cognitive processing necessary to explore "the problem structure, while attempting to create an analog" (Bernardo, 2001, p. 145).

To provide a general idea of the SQL and analogical problem construction used in this study, an example of the SQL EXCEPT clause is included. The purpose of the EXCEPT clause is used to combine two SELECT statements returning rows from the first that are NOT returned in the second. The following SQL code would return employees that are not assigned to a project.

```
SELECT LastName, FirstName
FROM EMPLOYEE

EXCEPT

SELECT LastName, FirstName
FROM PROJECT;
```

Below is a student analogical problem construction example for The EXCEPT code. Even for those without a background in SQL, this analogy is easily understood.

> Let's say you go to the Hogle Zoo for the day. You then walk up to a zookeeper and want to know all of the mammals they have in the zoo EXCEPT for the ones on two legs. The zookeeper will then proceed to tell you all mammals they have that do not walk on only two legs, giving you exactly the information you want.

Based on the student's analogical problem construction, the code that would illustrate the EXCEPT clause analogy code might look something like:

```
SELECT    Mammal_Name
FROM      ANIMAL

EXCEPT

SELECT Mammal_Name
FROM      ANIMAL
WHERE Mammal_Legs IN (2);
```

As a result, taking a new, abstract concept such as the EXCEPT clause, and linking this new knowledge to personal knowledge (i.e., Hogle Zoo example), allows personal knowledge to help link to meaningful and effective learning (Seyihoglu and Ozgurbuz, 2015).

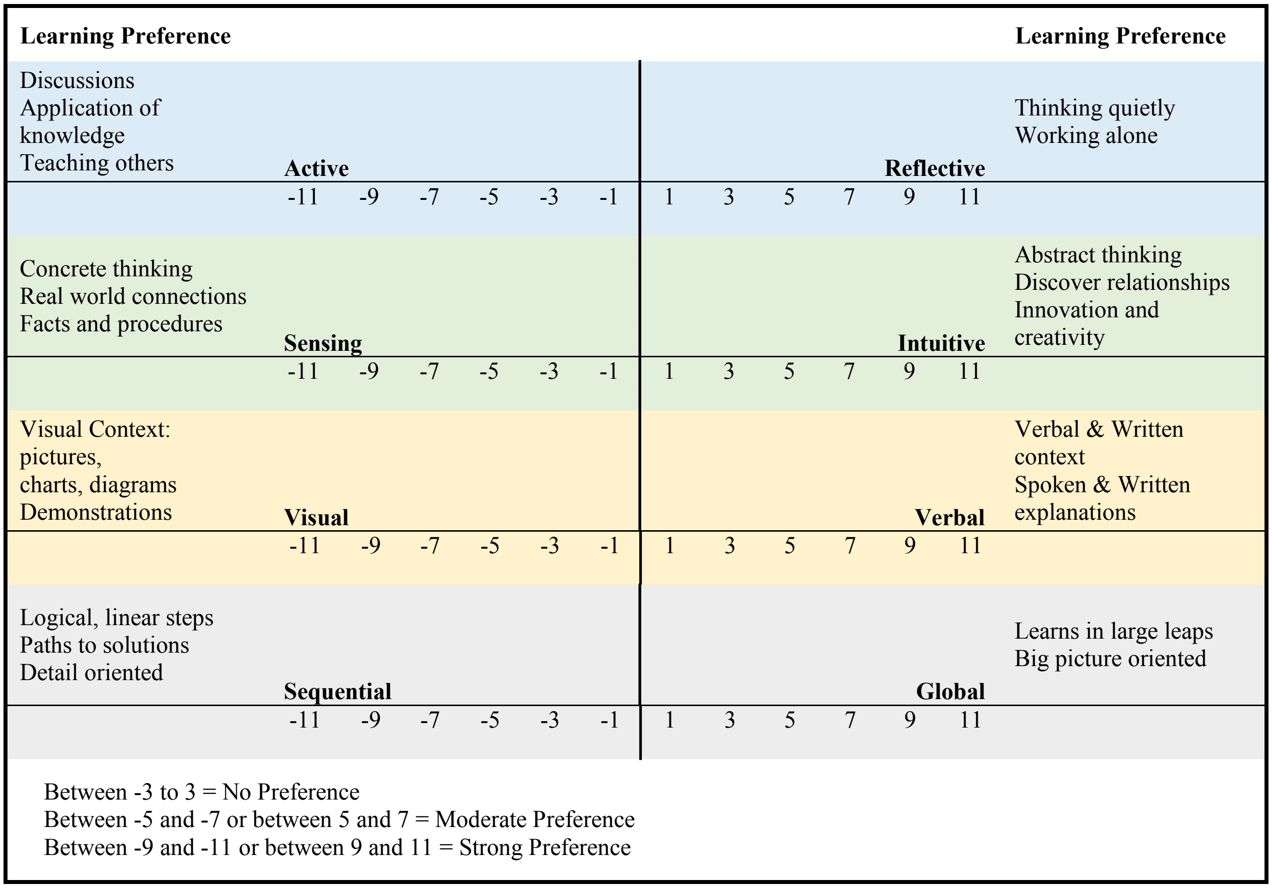
2.2 Learning Styles

Educators and researchers often emphasize the importance of understanding each individual's unique learning approaches, in order to enhance the learning experience. While there is no common definition of learning style or a unified theory upon which learning style research is grounded (Merriam, Caffarella, and Baumgartner, 2007), individuals seem to have identifiable and preferred ways of processing information, perceiving, thinking, remembering, and problem solving in any given situation (James and Galbraith, 1985). James and Galbraith concluded "experts generally concede that every person has a unique approach to learning; however, the experts do not agree on how to define or explain a learning style" (p. 163). Learning style is a construct representing various identifiable and pervasive traits, characteristics, behaviors, and qualities a student exhibits in a given educational setting. "Learning styles are preferences and tendencies students have for certain ways of taking in and processing information and responding to different instructional environments" (Felder, 2010, p. 4).

Researchers have developed various learning style theories and models by studying the learning process and individual's accustomed ways of learning. Keefe and Ferrell (1990) note that for this reason and because "many investigators tied theory development to the development of assessment instrumentation, the field of learning styles is in the multiparadigmatic stage" (p. 57). Some concede that research studies have failed to provide significant evidence that the concept of learning style really exists and therefore is not useful in teaching and research (Coffield et al., 2004; Pashler et al., 2009; Willingham, Hughes, and Dobolyi, 2015) while others suggest research does support responsible use of the construct of learning style (Felder, 2010; Felkel and Gosky, 2012). Due to the diverging approaches and the wide range of both respectable and poor research studies, there is common confusion about learning styles. Felder (2010) suggests that "although their validity is routinely challenged in the psychology literature, the most common learning styles models are used frequently and successfully to help teachers design effective instruction; help students better understand their own learning processes; and help both teachers and students realize that not everyone is like them and the differences are often worth celebrating" (p. 5).

Several recent studies in the field of information systems have employed learning style as a viable construct (Cegielski, Hazen, and Rainer, 2011; Recker, Reijers, and van de Wouw, 2014; Sandman, 2014). A recent study examined learning styles and object-oriented computer programming and found performance increases when the instructional strategies closely matched the student's learning style (Cegielski, Hazen, and Rainer, 2011). The research "serve[s] as a foundation from which to launch a detailed research agenda in the area of learning styles within the IS educational domain" (Cegielski, Hazen, and Rainer, 2011, p. 144).

Merriam and colleagues (2007) suggest "despite the lack of uniform agreement about which elements constitute a learning style, it seems apparent that learning-style inventories… have proved useful in helping learners and instructors alike become aware of their personal learning styles and their strengths and weaknesses as learners and teachers" (p. 409). The Inventory of Learning Styles (ILS) measures the four dimensions of learning purposed in Felder and Silverman's (1988) learning style model. See Figure 1 for a summary of ILS learning dimensions. The instrument classifies students as having a preference for one of two categories in four dimensions. The dimensions include: (a) sensing (concrete thinker, practical, oriented toward facts



Learning Preference			Learning Preference
Discussions Application of knowledge Teaching others	**Active**	**Reflective**	Thinking quietly Working alone
	-11 -9 -7 -5 -3 -1	1 3 5 7 9 11	
Concrete thinking Real world connections Facts and procedures	**Sensing**	**Intuitive**	Abstract thinking Discover relationships Innovation and creativity
	-11 -9 -7 -5 -3 -1	1 3 5 7 9 11	
Visual Context: pictures, charts, diagrams Demonstrations	**Visual**	**Verbal**	Verbal & Written context Spoken & Written explanations
	-11 -9 -7 -5 -3 -1	1 3 5 7 9 11	
Logical, linear steps Paths to solutions Detail oriented	**Sequential**	**Global**	Learns in large leaps Big picture oriented
	-11 -9 -7 -5 -3 -1	1 3 5 7 9 11	

Between -3 to 3 = No Preference
Between -5 and -7 or between 5 and 7 = Moderate Preference
Between -9 and -11 or between 9 and 11 = Strong Preference

Figure 1. Summary of ILS Learning Dimensions

procedures) or intuitive (abstract thinker, innovative, oriented toward theories and underlying meanings); (b) visual (prefer visual representations of material) or verbal (prefer written or spoken explanations); (c) active (learn by trying things out, enjoys working in groups) or reflective (learn by thinking things through, prefer working alone); and (d) sequential (linear thinking process, learn in small incremental steps) or global (holistic thinking process, learn in large leaps). Research studies across a variety of disciplines including engineering, sciences, humanities, and business use the ILS, and the online version of the instrument is administered over 100,000 times per year (Felder and Spurlin, 2005). The reliability estimate of the ILS based on Cronbach's alpha is between .56 and .77 (Litzinger et al., 2007).

3. RESEARCH METHODOLOGY

3.1 Population and Sample

Data were collected over two semesters (fall, 2014, and spring, 2015) by students taking a database management course. Although the course is required for MIS students, which accounts for two thirds of the total enrollment, other majors such as actuarial science, marketing, journalism, accounting, business administration, economics, and finance were also taking the class as an elective. The data collection process occurred in two phases. The first phase included a take-home activity for the database concepts course. During this phase, participants were tasked with creating analogies for a series of database introductory concepts. Students were allowed a week to complete the take-home activity (see Appendix 1). This activity was tested and refined one semester prior to data collection for this study. The second phase included a research questionnaire (see Appendix 2) consisting of 53 questions. The survey included: (a) demographic questions, (b) questions related to analogical learning, and (c) the Index of Learning Styles (ILS) instrument. In addition, the survey was pre-tested by three students who took the database management course during initial treatment implementation.

3.1.1 Phase One – Instructional Treatment: The instructional treatment included a specific task related to analogical problem construction. This activity roughly followed a 'Reflective-Intuitive-Visual-Sequential' (see Table 1) approach. Further support for this classification is based on prior research by Cellucci et al., who suggest "reflective learners prefer to cogitate and internally process new information" (2011, p. 136). The 'Intuitive' approach supports creativity and innovation, required in this assignment. The classification between 'Visual' and 'Verbal' was more challenging. Although the assignment appeared to highlight a 'Verbal' approach, the vividness of the student analogies required a 'Visual' approach (e.g. a drawer full of socks). Finally, the activity is a 'Sequential' approach as it required following very specific SQL code and is detailed oriented.

(DISTINCT, LIKE, INNER JOIN, FULL OUTER JOIN, SUBQUERY)	
Learning Style	**Learning Style Elements**
Reflective	Thinking quietly and working alone
Intuitive	Abstract thinking; Discover relationships; Innovation and creativity
Visual	Visual context
Sequential	Paths to solutions; Detail oriented

Table 1. Analogical Problem Construction Teaching Approach

The analogical problem construction activity was designed as part of an exam review and included five SQL terms/concepts; DISTINCT, LIKE, INNER JOIN, OUTER JOIN, and SubQuery. Students worked independently on the analogy problem constructions, were given a week to complete the activity, and were provided an analogy construction example based on an SQL Case Expression (see Appendix 1).

3.1.2 Phase Two – Research Questionnaire: Prior to commencement of the research, students were informed of the research procedures and their right to decline participation. Each prospective participant received a letter describing the purpose of the research, the conditions of their participation, and an assurance of confidentiality. Students who agreed to participate signed an informed consent form approved by the university Institutional Review Board (IRB). The procedures and methodological approach in this study presented little physical or psychological risk to participants.

A five-page research questionnaire was used to collect data for this study. The questionnaire contained three sections, a general demographic survey, questions related to analogical learning, and the Index of Learning Styles (ILS). The demographics section was designed to measure the categorical variables of gender and course type. The second section was designed to measure the perceived benefits of analogical learning in relationship to the course SQL take-home activity. This section included seven questions with 5-point Likert scales. The Index of Learning Styles (ILS) developed by Felder and Soloman was used in this study to measure the preferred learning styles of the participants (Felder and Soloman, n.d). Felder and Soloman developed the ILS based on the learning style model proposed by Felder and Silverman (1988). The ILS is accepted as a reliable and valid rating scale in a variety of educational environments with numerous studies test-retest reliability, internal consistency reliability, inter-scale orthogonality, factor analysis, and construct validity (Cook and Smith, 2006; Felder and Spurlin, 2005; Felkel and Gosky, 2012; Filippidis and Tsoukalas, 2009; Hwang et al., 2012; Litzinger et al., 2007; Mampadi et al., 2011). Felder and Spurlin (2005) highlight many reliability and validity studies that justify a claim that the ILS is a suitable instrument for assessing learning styles.

The ILS instrument items were drawn from the Felder and Silverman learning style model (1988) that classifies students as having learning preferences in four dimensions: (1) active/reflective, (2) sensing/intuitive, (3) visual/verbal, and (4) sequential/global. The dimensions parallel other learning style models with each being analogous to various dimensions drawn from theoretical principles in learning style literature (Felder and Spurlin, 2005). The instrument consists of 44 dichotomous questions used to assess characteristic strengths and preferences on the four dimensions of the Felder-Silverman Model. "Each learning style dimension has associated with it 11 force-choiced items, with each option (a or b) corresponding to one or the other category of the dimension (e.g. active or reflective)" (Felder and Spurlin, 2005, p. 104). Item scoring for each dimension results in an integer ranging from -11 to 11 with 'b' responses subtracted from 'a' responses to achieve a score for each dimension. Scores falling in the -3 to 3 range indicate no preference toward any dimension; those between -5 and -7 or between 5 and 7 suggest a moderate preference; while scores in the -9 to -11 or 9 to 11 range specify a strong preference (Felder and Soloman, n.d.). See Figure 1 for a visual display of scoring procedures.

4. DATA ANALYSIS AND RESULTS

Eighty students across two semesters were given the ILS survey along with the seven questions concerning their perception of the effectiveness of the analogy assignment. Demographics for gender and class were also collected. Before addressing the research questions, the data was examined for normality and missing values. Two responses were incomplete or contained indecipherable responses and were excluded from further analysis leaving the sample size at 78 responses. Each item's skewness was examined to check for normality of data. Responses showed a normal distribution for five out of the seven questions related to the analogy assignment, and the individual scores for each dimension of the ILS survey (i.e., Active/Reflective, Sensing/Intuitive, Visual/Verbal, and Sequential/Global). Only two items were outside the recommended skewness score of -1 to +1 (Nunnally, 1978), namely Q1 (skewness: -1.359) and Q2 (skewness: -1.236). Both of these items were maintained however as the variance from the recommended levels was minimal.

4.1 Research Question 1

What will students' perceptions be regarding the use of analogy problem construction to learn introductory database (SQL) concepts?

To answer this research question, the seven items regarding students' perceptions of the effectiveness of the analogy assignment were analyzed. The scores were mean centered, such that a score of "0" would indicate a student felt the effectiveness of the assignment was "neutral", a score of "-2" would indicate a perception of very ineffective and a score of "+2" would indicate a perception that the assignment was very effective. We propose the following hypotheses: **H0:** $\mu = 0$ and **Ha:** $\mu > 0$ or $\mu < 0$

Item	Mean	Std. Dev.	Sig
1. How would you rate the impact of the analogy assignment on your ability to understand the database concepts?	1.27	.693	***
2. How would you rate the impact of the analogy assignment on your ability to remember the database concepts after the semester is over?	1.24	.716	***
3. The analogy assignment improved my understanding of the database terms.	1.13	.624	***
4. I prefer the analogy assignment to a traditional reading assignment as a technique to better understand database terms.	1.13	.919	***
5. I believe the analogy assignment will have value for me beyond this class.	1.11	.656	***
6. I feel the analogy assignment was a good use of class time.	1.19	.735	***
7. I still remember: 0% of my Analogies (-2), 25% of my Analogies (-1), 50% of my Analogies (0), 75% of my analogies (+1), 100% of my Analogies (+2)	0.65	.251	***

Significance (2-tailed): * p < .05; ** p < .01, *** p < .001

Table 2. Summary Results of t-tests.

If the analogy assignment had no effect (positive or negative), we would expect that the sample mean would not be significantly different from 0, and accept H0. If we reject the null hypothesis (H0), then we can conclude that the analogy assignment was either effective (mean is positive), or ineffective (mean is negative). A 2-tailed t-test can be used to assess whether a sample mean varies significantly from the population. Table 2 presents a summary of the results, and indicates that for each of the seven items, the t-test was significant, thus H0 is rejected for each item, and we can conclude that students' perceived the analogy assignment as effective.

Conducting multiple t-tests on a single sample could lead to some issues, especially if the items are highly correlated. To test the robustness of our t-test, a factor analysis was performed to more clearly understand any relationships among the seven items. An exploratory factor analysis may be used to understand underlying patterns between items, and identify whether items can be combined or condensed into a smaller set of factors (Hair et al., 2010). Table 3 displays the results of the factor analysis, and indicates that three factors emerged from the data: Factor 1 (*Impact* of assignment), Factor 2 (*Effectiveness* of assignment), and Factor 3 (*Recall* of the assignment). A factor score for each student was computed by summing the scores of the items associated with each factor. Because the Recall factor contains only one item (Q7), no computation was necessary. Table 4 displays the mean, reliability (Cronbach's alpha), and correlations for each factor.

Due to the low correlations between factors, robustness in the item level t-test results may be demonstrated by conducting a t-test against the mean for Impact, Effectiveness, and Recall. Table 5 shows the outcome from the second set of t-tests which are significant, thus H0 may also be rejected at the factor level. These results are robust to collinearity, and demonstrate that students did perceive a benefit of the analogy problem construction assignment.

	Factor		
	1	2	3
Q1	**.994**		
Q2	**.553**		
Q3	**.474**		
Q4		**.670**	
Q5		**.702**	
Q6		**.847**	
Q7			**.816**

Table 3. Factor Analysis Result

	Mean	Cronbach's Alpha	Impact	Effectiveness	Recall
Impact	3.633	.74	1.000		
Effectiveness	3.405	.79	0.395	1.000	
Recall	0.552	n/a	0.360	0.368	1.000

Table 4. Factor Means, Reliability, Correlation

Factor	**t**	**df**	**Sig.**
Impact	23.054	78	***
Effectiveness	19.478	78	***
Recall	15.509	78	***

Table 5. Factor Level t-test Results

4.2 Research Question 2

What are the learning styles of students in introductory database courses based on the Felder-Soloman's Inventory of Learning Styles (ILS)?

Figure 2 illustrates the distribution of students across the 16 possible Index of Learning Styles (ILS) types. A majority of students identified their learning styles as 'Active-Sensing-Visual-Sequential.' This was different from the learning styles related to the activity, which used a 'Reflective-Intuitive-Visual-Sequential' approach. Figure 3 provides another illustration of these results in the form of a heat map.

A further analysis of each individual learning style indicates via a one-sample t-test, that MIS students differ in learning style from the general population (See Table 6). These results along with majority of students falling in the 'Reflective-Intuitive-Visual-Sequential' may indicate that students self-select into the MIS major.

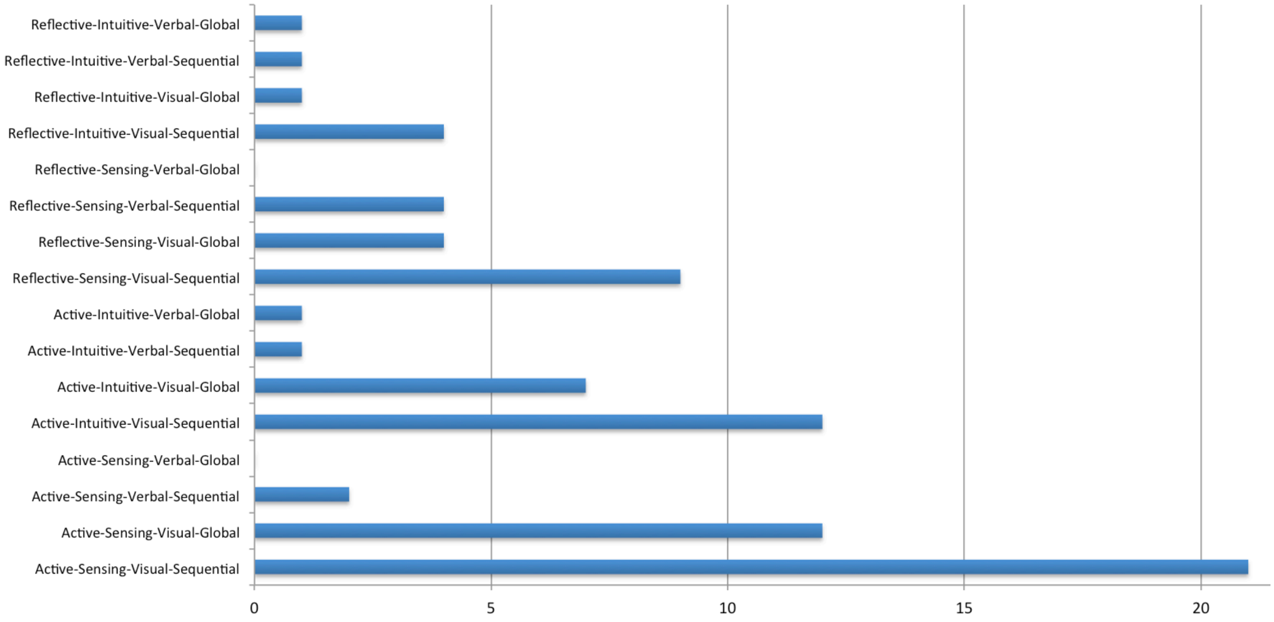
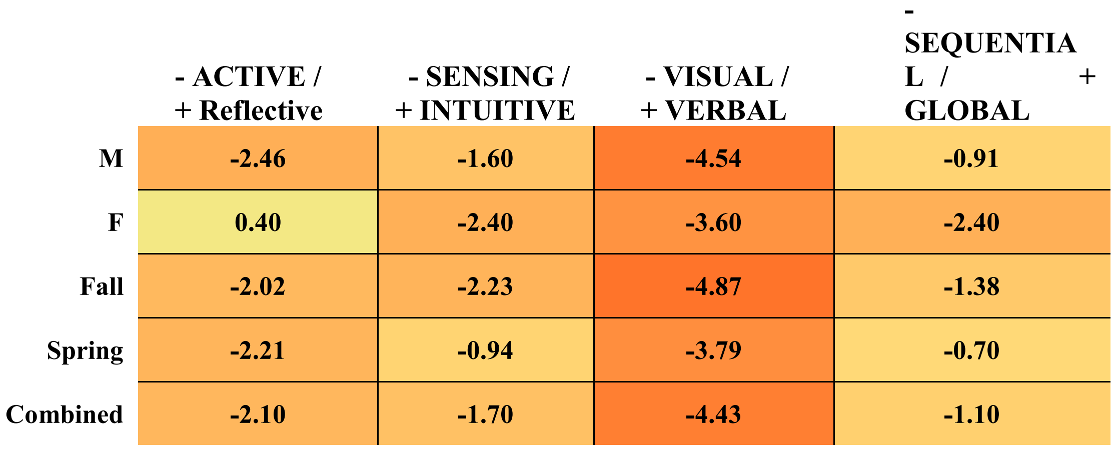


Figure 2. Distribution of the 16 Possible ILS Types



	- ACTIVE / + Reflective	**- SENSING / + INTUITIVE**	**- VISUAL / + VERBAL**	**- SEQUENTIAL / + GLOBAL**
M	**-2.46**	**-1.60**	**-4.54**	**-0.91**
F	**0.40**	**-2.40**	**-3.60**	**-2.40**
Fall	**-2.02**	**-2.23**	**-4.87**	**-1.38**
Spring	**-2.21**	**-0.94**	**-3.79**	**-0.70**
Combined	**-2.10**	**-1.70**	**-4.43**	**-1.10**

Figure 3. Heat Map of ILS Learning Dimensions

	Mean	Std. dev.	Sig.
-Active/ +Reflective	-2.1	4.315	***
-Sensing/ +Intuitive	-1.7	4.524	***
-Visual/ +Verbal	-4.43	4.307	***
-Sequential/ +Global	-1.1	3.599	***

Significance (2-tailed): * p < .05; ** p < .01, *** p < .001

Table 6. Felder-Soloman ILS Instrument t-test Results

	Impact		Effectiveness		Recall	
	Standardized Coefficient	Sig.	Standardized Coefficient	Sig.	Standardized Coefficient	Sig.
-Active/ +Reflective	-.232	.046 *	-.278	.016 *	-.089	.450 (ns)
Sensing/ +Intuitive	.039	.740 (ns)	.024	.837 (ns)	.139	.239 (ns)
-Visual/ +Verbal	-.017	.880 (ns)	-.099	.378 (ns)	.097	.406 (ns)
-Sequential/ +Global	.162	.162 (ns)	.122	.287 (ns)	-.087	.456 (ns)
R^2	.084		.109		.043	

Significance (2-tailed): * p < .05; ** p < .01, *** p < .001

Table 7. Regression Analysis Results

4.3 Research Question 3

How will students' perceived benefit of using analogical problem construction to learn introductory database (SQL) concepts be impacted by their specific learning style using the Felder-Soloman's Inventory of Learning Styles (ILS)?

In order to understand the effect learning styles may have on students' perceived benefit of the analogy assignment, a linear regression analysis was used. Due to the sample size, we were not able to test the impact of each of the 16 combinations (see Figure 2) on each of the perceived benefit factors. Instead, we test how each dimension of the ILS (Active/Reflective, Sensing/Intuitive, Visual/Verbal, and Sequential/Global) might influence the three factors identified as benefits of the analogy assignment (Impact, Effectiveness, Recall). Table 7 presents the results of the regression analyses.

The individual learning style dimensions only explain 8.4%, 10.9%, and 4.3% of the variance in Impact, Effectiveness, and Recall. While the results indicate some significance when the Active/Reflective learning style dimension is regressed on Impact and Effectiveness, the overall effect when the amount of variance explained (i.e., R^2) is accounted for is minimal. The results of the regression analyses demonstrate that a student's individual learning style does not seem to influence the perceived benefits of the analogy assignment.

4.4 Research Question 4

Do student examples of analogical problem construction related to SQL concepts in an introductory database course illustrate creativity and personal links to prior knowledge?

The study collected approximately 80 unique analogies for a variety of common SQL terms. Many of the analogies illustrate creativity and personal links to prior knowledge. While some analogies did not accurately portray the SQL term and contained logic error, Table 8 highlights six noteworthy student analogies related to SubQuery and Full Outer Join. Examples were selected to illustrate creativity, variety, and analogies that effectively described the SQL concepts in vivid detail. As a point of reference a SubQuery "involves placing an inner query (SELECT… FROM… WHERE…) within a WHERE or HAVING clause of another (outer) query" (Hoffer, Venkataraman, and Topi, 2016, p. 298). An OUTER JOIN is defined as "a join in which rows that do not have matching values in common columns are nevertheless included in the result table" (Hoffer, Venkataraman, and Topi, 2016, p. 293). The examples uniquely join (pun-intended) an individual's chosen prior knowledge to new SQL concepts. Contributors' names were specifically included (with formal approvals) to provide appropriate recognition.

DISTINCT

I'm a sucker for the $5 movie bins at Walmart, but the problem is as I filter through to see what movies are in the bin I without fail pickup at least 4 or 5 of the same movie when I dig through the bin. If they had a list of the titles that were available in the bin, I could see what was available and decide if it was worth digging through it. DISTINCT allows you to return just one instance of each entry in the column, so if there were 12 copies of Napoleon Dynamite, it would still only list it once.

--Aaron G.

LIKE

Think of the WHERE clause like a teenage girl. "You know that City WHERE LIKE the name is Denver?"

--Kameron P.

INNER JOIN

An INNER JOIN is oddly similar to a dating website that matches people with similar interests. In this type of search in order for there to be a match both potential love birds must have at least one same interest or there is no match and therefore, no potential for true love.

--Phillip E.

FULL OUTER JOIN

The Full Outer Join keyword combines the result of both left and right tables regardless if null values or not. This is ALOT like folding your socks, you match as many as possible and put them together, but when your almost finished you always have those stragglers left that don't match, but you still put them together and wear un-matching socks.

--Ryan K.

SubQuery

A subquery can be compared to a series of conveyer belts, depending on how many subqueries that you have, that is how many belts you will have. We start with the last subquery and work backwards. (Right to left) Whatever info /item is requested first is placed on the conveyer belt where it is brought to the next conveyer belt. If the items that are brought to that point match what is being requested at the next conveyer belt station, then that item is placed on the belt and brought back. This continues for as many subqueries as you have and ultimately will bring back specific items

--Aaron G.

Table 8. Student SQL Analogy Samples

5. DISCUSSION

The use of analogical problem construction to support SQL knowledge acquisition is promising. A majority of students perceived benefits of using analogy problem construction to learn introductory database (SQL) concepts. In addition, a majority of participants reported remembering their analogy constructions a month later. Although transparent to most students, an overriding design consideration of the treatment activity was to help bridge new knowledge (SQL) to a student's existing knowledge structure. In addition, the analogies were created by the students requiring tapping into each of their existing knowledge structures as opposed to someone else's (i.e. professor or textbook analogy). There were two unexpected findings based on the Felder-Soloman's Inventory of Learning Styles (ILS) instrument. First, a student's preferred learning style did not seem to influence perceived benefits of the analogy problem construction activity. The analogical problem construction activity was identified as a 'Reflective-Intuitive-Visual-Sequential' approach as described earlier. However, identified learning styles did not appear to make a difference in perceived benefits of the activity. In addition, the study sample was dominated by 'Active-Sensing-Visual-Sequential' learning styles. This raises the question of why so many IS students identified with these learning styles. This finding is very different than the few prior studies examining IS topics (e.g., objective oriented programming) and learning styles (Cegielski, Hazen, and Rainer, 2011). Our results indicate learning styles might not have as much impact when examining IS topics as was prior thought.

The research methodology used in this paper, describes the Instructional Treatment in terms of four distinct learning styles (i.e. 'Reflective-Intuitive-Visual-Sequential'), perhaps an equally valid case could be made that the analogical problem construction activity actually fits a different style.

For example, the study design identified taking the assignment home, working alone, and thinking quietly as a reflective activity. However, the overriding purpose of the assignment was an application of knowledge, which relates to the 'Active' learning style preference. In addition, the study design identified the assignment as involving abstract thinking, discovering relationships, and innovation and creativity as an 'Intuitive' activity. However, perhaps an equally valid argument could be the assignment suits 'Sensing' learning preferences as students created analogies to make real world connections, which relates to a sensing learning preference. The Instructional Treatment incorporates aspects associated with a variety of learning style dimensions. Identifying an instructional activity to a particular set of learning style preferences is difficult and perhaps a bit subjective and is therefore a limitation of the current study. Results coincide with previous research that highlights problems with the use of the construct 'Learning Style' in research studies (Coffield et al., 2004; Pashler et al., 2009; Willingham, Hughes, and Dobolyi, 2015).

Perhaps the most interesting finding from this research involves the analogical problem constructions themselves. Approximately 80 different analogies were created for each SQL term, each uniquely tying an individual's chosen prior knowledge to new SQL concepts. The analogies were creative, descriptive, and generated a customized learning experience. Of note, some analogies did not accurately portray the SQL term and contained logic errors. These errors should be used as a teaching moment to appropriately allow for corrective feedback.

Results of this study add to existing research that supports using analogy problem construction as an instructional strategy used to link prior knowledge to new knowledge (Catrambone and Holyoak, 1989; Gentner and Holyoak, 1997). Students were capable of creating their own analogies even though for most students, this was their first experience with SQL. Using analogy problem construction to enhance SQL learning and retention by tapping into existing knowledge structures is an innovation supported by this research as a new generation of data scientists are being trained.

6. CONCLUSION

6.1 Future Research

This study examined the perceived benefits of using analogy construction to learn introductory database (SQL) concepts. While the findings are intriguing, they underscore the need for further exploration in this area. Future studies should examine the connection between analogy construction and actual learning outcomes using an experimental research design. Results would prove beneficial in designing teaching strategies that help prepare IS students to solve complex business problems.

In this study, Felder-Soloman's Inventory of Learning Styles (ILS) instrument was used to ascertain specific learning styles of database students. Research questions were answered using a self-report format. Whether each student actually exhibits these learning styles in educational settings may not be independently discernable in this data. Therefore, a follow-up study should be conducted using observational research methods. Observing actual classroom behaviors would provide additional insight into the learning styles employed by students in IS classrooms. In addition, studies utilizing different learning style inventories—such as the Myers-Briggs Type Indicator or Kolb's Learning Style Inventory—would add to the knowledge base of the learning styles of IS students.

This study found no significant variation between student perceived benefits of analogy construction and learning styles. Future studies should explore this finding. In addition, why did so many students identify with the 'Reflective-Sensing-Visual-Sequential' learning style? Is there a relationship between this learning style and those who sign up for a database course? This study was conducted on students in database courses whose enrollment is comprised of mostly IS majors. Future studies might mitigate complications of self-selection of learning style preferences by studying students completing an introductory database module within core IS business courses.

This study shared examples of analogies submitted by students in an introductory database course. Students were asked to create analogies on the following five SQL terms/concepts: (a) DISTINCT, (b) LIKE, (c) INNER JOIN, (d) FULL OUTER JOIN, and (e) query. More advanced concepts such as correlated subqueries, case expressions and window functions should also be considered in future research to identify whether or not IS students perceive analogy problem construction beneficial in learning advanced SQL terms and concepts.

6.2 Summary

The demand for Information Systems (IS) graduates with expertise in Structured Query Language (SQL) and database management is vast and projected to increase as 'big data' becomes ubiquitous. Students in data-driven educational environments must be prepared to solve complex problems to thrive in the business world. Database education that centers solely on lectures and terminology-laden activities may fail to transfer the necessary knowledge to learners. To prepare students, IS educators must explore varied and creative instructional strategies in database education environments to help students link prior knowledge to new knowledge. This study sought to examine learning styles and the perceived benefits of analogical problem construction on SQL knowledge acquisition.

While the research results related to learning styles are intriguing and contribute to the knowledge base, the most promising path for further exploration is analogy problem construction in Information Systems education. Results suggest analogical problem construction helped create an improved grasp of the introductory database (SQL) concepts. This research provides a springboard for further contributions related to the benefits of analogical problem construction on SQL knowledge acquisition.

One challenge with knowledge is that as our memories become less vivid, we tend to be less confident about the knowledge we possess (Audi, 2011). Socrates suggested "true opinions…escape from a man's mind, so that they are not worth much until one ties them down" (Feldman, 2003, p. 16). Based on results of this study, incorporating analogical problem construction into learning SQL may help to enhance vivid memories and help tie down true opinions to improve knowledge retention, transfer, and application in the context of database concepts.

7. REFERENCES

Audi, R. (2011). *Epistemology: A Contemporary Introduction to the Theory of Knowledge.* New York: Routledge.

Bell, C., Mills, R., & Fadel, K. (2013). An Analysis of Undergraduate Information Systems Curricula: Adoption of the IS 2010 Curriculum Guidelines. *Communications of the Association for Information Systems*, 32(2), 73-94.

Bernardo, A. (2001). Analogical Problem Construction and Transfer in Mathematical Problem Solving. *Educational Psychology*, 21(2), 137-150.

Bostrom, R., Olfman, L., & Sein, M. (1990). The Importance of Learning Style in End User Training. *MIS Quarterly*, 14(1), 101-119.

Catrambone, R. & Holyoak, K. (1989). Overcoming Contextual Limitations on Problem-solving Transfer. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 15(6), 1147-1156.

Cegielski, C., Hazen, B., & Rainer, R. (2011). Teach Them how They Learn: Learning Styles and Information Systems Education. *Journal of Information Systems Education*, 22(2), 135-146.

Cellucci, L., Layman, E., Campbell, R., & Zeng, X. (2011). Integrating Healthcare Ethical Issues into IS Education. *Journal of Information Systems Education*, 22(3), 215-224.

Chen, H., Chiang, R., & Storey, V. (2012). Business Intelligence and Analytics: From Big Data to Big Impact. *MIS Quarterly*, 36(4), 1165-1188.

Chiang, R., Goes, P., & Stohr, E. (2012). Business Intelligence and Analytics Education and Program Development: A Unique Opportunity for the Information Systems Discipline. *ACM Transactions on Management Information Systems*, 3(3), 1-30.

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). Learning Styles and Pedagogy in Post-16 Learning: A Systematic and Critical Review. *Learning and Skills Research Centre, London.* Retrieved from http://sxills.nl/lerenlerennu/bronnen/Learning%20styles%20by%20Coffield%20e.a..pdf

Cook, D. & Smith, A. (2006). Validity of Index of Learning Styles Scores: Multitrait-Multimethod Comparison with Three Cognitive/Learning Style Instruments. *Medical Education*, 40(9), 900-907

Cosgrove, M. (1995). A Study of Science-in-the-making as Students Generate an Analogy for Electricity. *International Journal of Science Education*, 17(3), 295-310.

Cummins, D. (1992). The Role of Analogical Reasoning in the Induct of Problem Categories. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 18, 1103-1124.

De Vita, G. (2001). Learning Styles, Culture and Inclusive Instruction in the Multimedia Classroom: A Business and Management Perspective. *Innovations in Education and Teaching International*, 38(2), 165-174.

Dincer, S. (2011). Exploring the Impacts of the Analogies on Computer Hardware. *The Turkish Online Journal of Educational Techology*, 10(2), 113-121.

Felder, R. (1993). Reaching the Second Tier: Learning and Teaching Styles in College Science Education. *Journal of College Science Teaching*, 23(5), 286-290.

Felder R. (2010). Are Learning Styles Invalid? (Hint: No!). *On Course Workshops*. Retrieved from http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/LS_Validity(On-Course).pdf

Felder, R. & Silverman, L. (1988). Learning and Teaching Styles in Engineering Education. *Engineering Education*, 78(7), 674-681.

Felder, R. & Soloman, B. (n.d.). Index of Learning Styles. Retrieved from http://www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSpage.html

Felder, R. & Spurlin, J. (2005). Applications, Reliability and Validity of the Index of Learning Styles. *International Journal of Engineering Education*, 21(1), 103-112.

Feldman, R. (2003). *Epistemology*. Upper Saddle River: Pearson.

Felkel, B. & Gosky, R. (2012). A Study of Reliability and Validity of the Felder-Soloman Index of Learning Styles for Business Students. *Proceedings of the Annual International Conference on Technology in Collegiate Mathematics*.

Filippidis, S. & Tsoukalas, L. (2009). On the Use of Adaptive Instructional Images Based on the Sequential-Global Dimension of the Felder–Silverman Learning Style Theory. *Interactive Learning Environments*, 17(2), 135-150.

Flinders, K. (2011). Software Skills Survey Reveals SQL Highest in Demand Followed by C Programmers. *Computer Weekly*. Retrieved from http://www.computerweekly.com/news/2240106164/Software-skills-survey-reveals-SQL-highest-in-demand-followed-by-C-programmers

Gentner, D., Loewenstein, J., & Thompson L. (2003). Learning and Transfer: A General Role for Analogical Encoding. *Journal of Educational Psychology*, 95(2), 393–408.

Gentner, D. & Holyoak, K. (1997). Structure Mapping in Analogy and Similarity. *American Psychologist*, 52(1), 45-56.

Hair, J., Black, W., Babin, B., Anderson, R., & Tatham, R. (2010). *Multivariate Data Analysis (7 ed.)*. Upper Saddle River: Pearson Prentice Hall.

Hoffer, J., Venkataraman, R., & Topi, H. (2016). *Modern Database Management*. Upper Saddle River: Pearson.

Houde, J. (2007). Analogically Situated Experiences: Creating Insight Through Novel Contexts. *Academy of Management Learning and Education*, 6(3), 321-331.

Hwang, G., Sung, H., Hung, C., Huang, I., & Tsai, C. (2012). Development of a Personalized Educational Computer Game based on Students' Learning Styles. *Educational Technology Research and Development*, 60(4), 623-638.

James, W. & Galbraith, M. (1985). Perceptual Learning Styles: Implications and Techniques for Practitioner. *Lifelong Learning: An Omnibus of Practice and Research*, 8(4), 163-166.

Kadlec, J. (2008). SQL Server Developer T-SQL Interview Questions. Retrieved from https://www.mssqltips.com/sqlservertip/1450/sql-server-developer-tsql-interview-questions/

Keefe, J. & Ferrell, B. (1990). Defining a Defensible Learning Style Paradigm. *Educational Leadership*, 48(2), 57-61.

Litzinger, T., Lee, S., Wise, J., & Felder, R. (2007). A Psychometric Study of the Index of Learning Styles. *Journal of Engineering Education*, 96(4), 309-319.

Lomas, N. (2011). SQL and SQL Server Skills in Highest Demand. *ZDNet*. Retrieved from http://www.zdnet.com/article/sql-and-sql-server-skills-in-highest-demand/

Mampadi, F., Chen, S., Ghinea, G., & Chen, M. (2011). Design of Adaptive Hypermedia Learning Systems: A Cognitive Style Approach. *Computers and Education*, 56(4), 1003-1011.

Merriam, S., Caffarella, R., & Baumgartner, L. (2007). *Learning in Adulthood: A Comprehensive Guide (3 ed.)*. San Francisco: Jossey-Bass.

Novick, L. & Holyoak, K. (1991). Mathematical Problem Solving by Analogy. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 17(3), 398-415.

Nunnally, J. (1978). *Psychometric Methods*. New York: McGraw-Hill.

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2009). Learning Styles: Concepts and Evidence. *Psychological Science in the Public Interest*, 9(3), 105–119.

Recker, J., Reijers, H., & van de Wouw, S. (2014). Process Model Comprehension: The Effects of Cognitive Abilities, Learning Style, and Strategy. *Communications of the Association for Information Systems*, 34(9), 199-222.

Sandman, T. (2014). A Preliminary Investigation into the Adaptive Learning Styles of Business Students. *Decision Sciences Journal of Innovative Education*, 12(1), 33-54.

Schank, R. (2002). *Designing World-class E-learning: How IBM, GE, Harvard Business School, and Columbia University are Succeeding at E-learning*. Boston: McGraw-Hill.

Seyihoglu, A. & Ozgurbuz, I. (2015). Analysis of Analogies in Geography Textbooks. *Education and Science*, 40(179), 163-179.

Soat, J. (2014). As Big Data Booms, SQL Makes a Comeback. *Forbes*. Retrieved from http://www.forbes.com/sites/oracle/2014/09/08/as-big-data-booms-sql-makes-a-comeback/

Tang, H., Lee, S., & Koh, S. (2000). Educational Gaps as Perceived by IS Educators: A Survey of Knowledge and Skill Requirements. *Journal of Computer Information Systems*, 41(2), 76-84.

Togo, D. (2002). Topical Sequencing of Questions and Advance Organizers Impacting on Student's Examination Performance. *Accounting*, 11(3), 203-216.

Willingham, D., Hughes, E., & Dobolyi, D. (2015). The Scientific Status of Learning Styles Theories. *Teaching of Psychology*, 42(3), 266–271.

Zheng, R., Yang, W., Garcia, D., & McCadden, E. (2008). Effects of Multimedia and Schema Induced Analogical Reasoning on Science Learning. *Journal of Computer Assisted Learning*, 24(6), 474-482.

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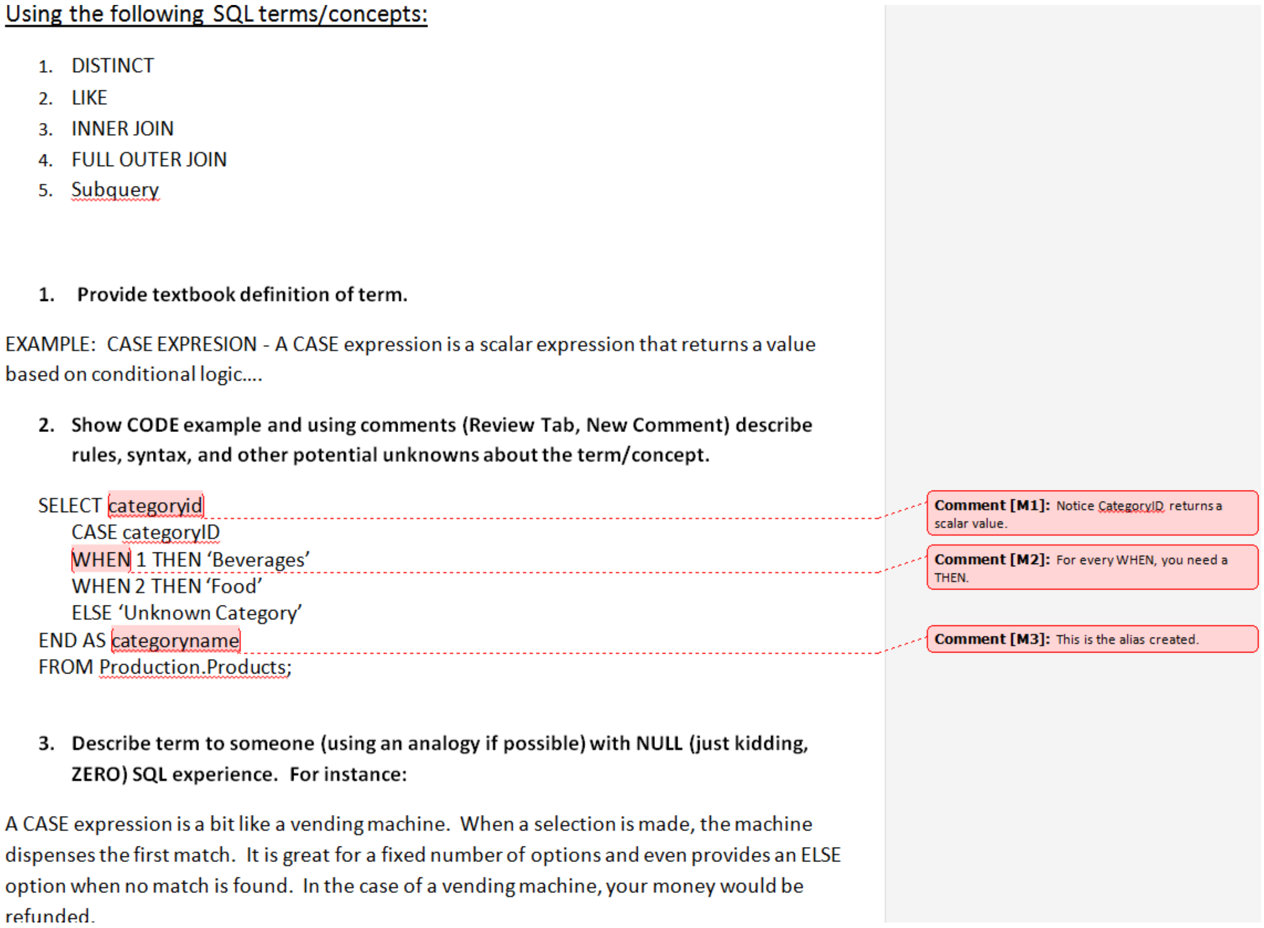
APPENDIX 1: ANALOGY CREATION ACTIVITY



Using the following SQL terms/concepts:

1. DISTINCT
2. LIKE
3. INNER JOIN
4. FULL OUTER JOIN
5. Subquery

1. **Provide textbook definition of term.**

EXAMPLE: CASE EXPRESION - A CASE expression is a scalar expression that returns a value based on conditional logic….

2. **Show CODE example and using comments (Review Tab, New Comment) describe rules, syntax, and other potential unknowns about the term/concept.**

```
SELECT categoryid
    CASE categoryID
    WHEN 1 THEN 'Beverages'
    WHEN 2 THEN 'Food'
    ELSE 'Unknown Category'
END AS categoryname
FROM Production.Products;
```

Comment [M1]: Notice CategoryID returns a scalar value.

Comment [M2]: For every WHEN, you need a THEN.

Comment [M3]: This is the alias created.

3. **Describe term to someone (using an analogy if possible) with NULL (just kidding, ZERO) SQL experience. For instance:**

A CASE expression is a bit like a vending machine. When a selection is made, the machine dispenses the first match. It is great for a fixed number of options and even provides an ELSE option when no match is found. In the case of a vending machine, your money would be refunded.

APPENDIX 2: RESEARCH QUESTIONNAIRE

Instructions: Earlier this semester you participated in an activity where you developed analogies for SQL terms. Please answer the following questions by selecting the option that best describes your reaction to the activity.

1. How would you rate the impact of the Analogy Assignment on your ability to understand the database concepts? *Significantly Improved, Slightly Improved, No Effect, Slightly Counterproductive, Significantly Counterproductive*
2. How would you rate the impact of the Analogy Assignment on your ability to remember the database concepts after the semester is over? *Significantly Improved, Slightly Improved, No Effect, Slightly Counterproductive, Significantly Counterproductive*
3. The analogy assignment improved my understanding of the database terms. *Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree*
4. I prefer the analogy assignment to a traditional reading assignment as a technique to better understand database terms. *Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree*
5. I believe the analogy assignment will have value for me beyond this class. *Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree*
6. I feel the analogy assignment was a good use of class time. *Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree*
7. I still remember: *0% of my Analogies, 25% of my Analogies, 50% of my Analogies, 75% of my Analogies, 100% of my Analogies*

For each of the questions select either "a" or "b" to indicate your answer. Choose only one answer for each question. If both "a" and "b" seem to apply to you, choose the one that applies more frequently.

1. I understand something better after I *(a) try it out. (b) think it through.*
2. I would rather be considered *(a) realistic. (b) innovative.*
3. When I think about what I did yesterday, I am most likely to get *(a) a picture. (b) words.*
4. I tend to *(a) understand details of a subject but may be fuzzy about its overall structure. (b) understand the overall structure but may be fuzzy about details.*
5. When I am learning something new, it helps me to *(a) talk about it. (b) think about it.*
6. If I were a teacher, I would rather teach a course *(a) that deals with facts and real life situations. (b) that deals with ideas and theories.*
7. I prefer to get new information in *(a) pictures, diagrams, graphs, or maps. (b) written directions or verbal information.*
8. Once I understand *(a) all the parts, I understand the whole thing. (b) the whole thing, I see how the parts fit.*
9. In a study group working on difficult material, I am more likely to *(a) jump in and contribute ideas. (b) sit back and listen.*
10. I find it easier *(a) to learn facts. (b) to learn concepts.*
11. In a book with lots of pictures and charts, I am likely to *(a) look over the pictures and charts carefully. (b) focus on the written text.*
12. When I solve math problems *(a) I usually work my way to the solutions one step at a time. (b) I often just see the solutions but then have to struggle to figure out the steps to get to them.*
13. In classes I have taken *(a) I have usually gotten to know many of the students. (b) I have rarely gotten to know many of the students.*
14. In reading nonfiction, I prefer *(a) something that teaches me new facts or tells me how to do something. (b) something that gives me new ideas to think about.*
15. I like teachers *(a) who put a lot of diagrams on the board. (b) who spend a lot of time explaining.*
16. When I'm analyzing a story or a novel *(a) I think of the incidents and try to put them together to figure out the themes. (b) I just know what the themes are when I finish reading and then I have to go back and find the incidents that demonstrate them.*
17. When I start a homework problem, I am more likely to (*a) start working on the solution immediately. (b) try to fully understand the problem first.*

18. I prefer the idea of *(a) certainty. (b) theory.*
19. I remember best *(a) what I see. (b) what I hear.*
20. It is more important to me that an instructor *(a) lay out the material in clear sequential steps. (b) give me an overall picture and relate the material to other subjects.*
21. I prefer to study *(a) in a study group. (b) alone.*
22. I am more likely to be considered *(a) careful about the details of my work. (b) creative about how to do my work.*
23. When I get directions to a new place, I prefer *(a) a map. (b) written instructions.*
24. I learn *(a) at a fairly regular pace. If I study hard, I'll "get it." (b) in fits and starts. I'll be totally confused and then suddenly it all "clicks."*
25. I would rather first *(a) try things out. (b) think about how I'm going to do it.*
26. When I am reading for enjoyment, I like writers to *(a) clearly say what they mean. (b) say things in creative, interesting ways.*
27. When I see a diagram or sketch in class, I am most likely to remember *(a) the picture. (b) what the instructor said about it.*
28. When considering a body of information, I am more likely to *(a) focus on details and miss the big picture. (b) try to understand the big picture before getting into the details.*
29. I more easily remember *(a) something I have done. (b) something I have thought a lot about.*
30. When I have to perform a task, I prefer to *(a) master one way of doing it. (b) come up with new ways of doing it.*
31. When someone is showing me data, I prefer *(a) charts or graphs. (b) text summarizing the results.*
32. When writing a paper, I am more likely to *(a) work on (think about or write) the beginning of the paper and progress forward. (b) work on (think about or write) different parts of the paper and then order them.*
33. When I have to work on a group project, I first want to *(a) have "group brainstorming" where everyone contributes ideas. (b) brainstorm individually and then come together as a group to compare ideas.*
34. I consider it higher praise to call someone *(a) sensible. (b) imaginative.*
35. When I meet people at a party, I am more likely to remember *(a) what they looked like. (b) what they said about themselves.*
36. When I am learning a new subject, I prefer to *(a) stay focused on that subject, learning as much about it as I can. (b) try to make connections between that subject and related subjects.*
37. I am more likely to be considered *(a) outgoing. (b) reserved.*
38. I prefer courses that emphasize *(a) concrete material (facts, data). (b) abstract material (concepts, theories).*
39. For entertainment, I would rather *(a) watch television. (b) read a book.*
40. Some teachers start their lectures with an outline of what they will cover. Such outlines are *(a) somewhat helpful to me. (b) very helpful to me.*
41. The idea of doing homework in groups, with one grade for the entire group, *(a) appeals to me. (b) does not appeal to me.*
42. When I am doing long calculations, *(a) I tend to repeat all my steps and check my work carefully. (b) I find checking my work tiresome and have to force myself to do it.*
43. I tend to picture places I have been *(a) easily and fairly accurately. (b) with difficulty and without much detail.*
44. When solving problems in a group, I would be more likely to *(a) think of the steps in the solution process. (b) think of possible consequences or applications of the solution in a wide range of areas.*

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