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Give Me a Formula Not the Concept! Student Preference to Mathematical Problem Solving

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Purpose of Study: The purpose of this study was to assess student preference for procedural (formula-driven) versus conceptual (concept-driven) approaches to solve mathematical problems. Additionally, we evaluated differences in preferences among students who performed above average and those who performed at or below average on simple arithmetic problems.

Methods/Design and Sample: We used a single-factor (Instructional Approach: conceptual vs. procedural) between-subjects experiment. Instructional approach was manipulated using short embedded instructional videos. Students evaluated each approach on a five-point scale.

Results: We found that students (above-average and average/below-average) preferred the procedural approach to the conceptual approach. Interestingly, however, although students preferred the procedural approach when first introduced to it, above-average students evaluated the conceptual approach more positively if they were unable to solve a problem correctly and were presented with additional conceptual instruction. On the other hand, there was no change in the evaluation of the procedural approach.

Value to Marketing Educators: The findings of this study indicate that students develop mathematical knowledge and understanding differently. Faculty who teach courses with a high degree of mathematics concepts should work to provide multiple experiences that include both procedural and conceptual techniques to develop a holistic understanding of mathematics.

Keywords: mathematics; procedural knowledge; conceptual knowledge; problem solving; critical thinking

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Marketers continually assert the importance of basic quantitative and analytical skills for marketing graduates because the discipline requires frequent applications of data analysis and predictive analytical techniques (Ganesh, Sun, & Barat, 2010). However, a significant proportion of marketing students have inadequate preparation and abilities to perform simple mathematics computations required to prepare them for future careers (Brennan & Vos, 2013; Green & Kirpalani, 2013). It has even been reported that marketing majors are at the lowest level of performance in quantitative skills compared to other business majors (Aggarwal, Vaidyanathan, & Rochford, 2007). Knowledge of basic mathematical concepts is critical for successful performance in a variety of roles such as purchasing and inventory management, wherein success is rooted in a person's ability to perform basic data analysis and to identify, understand, and predict future trends (Ganesh et al., 2010). Although students may be familiar with mathematical procedures, they often lack confidence and understanding of how to use the mathematical processes and apply them to real-world situations (Toppo, 2004). Furthermore, students lacking confidence in mathematics often fail to translate previously learned concepts to new contexts (Boaler, 1993). It is important to address these challenges in order to prepare students with the necessary mathematical skills needed for the workplace (Ganesh et al., 2010; Aggarwal et al., 2007).

In mathematics, both procedural and conceptual knowledge are vital for a holistic understanding (Eisenhart et al., 1993). Procedural knowledge may be defined as knowing "rules without reasons" (Skemp, 1976). In other words, students may perform mathematics by use of a rule or procedure without any real understanding of why they are doing it. On the other hand, conceptual understanding means knowing what to do and why. Students have a deeper understanding of concepts and are able to move beyond explanations focused on formulas or algorithms required to solve problems. Conceptual understanding allows one to translate previously learned mathematical concepts to new contexts. However, students may regard procedural understanding as the final outcome of mathematics, thereby lacking the conceptual understanding of "what the numbers mean and why" (Mahir, 2009). Consequently, there can be a mismatch between the teacher's intended goal of holistic understanding (procedural and conceptual learning) and the student's learning outcomes of narrow procedural learning (Skemp, 1976). It is this type of holistic understanding and knowledge that we are interested in examining.

Accordingly, the overall goal of this research is to investigate the student preference for procedural versus conceptual knowledge and learning as it relates to college-level retail mathematics coursework. We also investigate whether there is a difference in preference for procedural versus conceptual knowledge between students who perform above average or are situated for success and students who perform at or below average or are apt to fail on a given set of simple mathematics computations commonly used in retail mathematics.

QUANTITATIVE SKILLS

Despite the steady demand for marketing majors, data has suggested a decline in the quality of students choosing marketing majors (Aggarwal, Vaidyanathan, & Rochford, 2007). Aggarwal et al. (2007) examined several measures of quality of undergraduate marketing majors, including SAT score, GMAT score, starting salary, and chief executive officer rating. They found that out of all business majors, marketing majors scored lowest on all of these dimensions, with lack of quantitative skills being the key weakness. Furthermore, marketing students perceive themselves as poorer in quantitative skills than non-marketing majors and often consider quantitative coursework as unimportant (Newell, Titus, & West, 1996; LaBarbera & Simonoff, 1999). In a similar vein, Davis, Misra, and Auken (2002) conducted a gap analysis among a sample of marketing alumni. They contrasted the importance of key skill and knowledge areas of their current employment with perceptions of their academic preparation in these areas. They found that the marketing alumni perceived that they were underprepared in key skills, including ability to effectively use statistical packages. The findings of these studies reveal both managerial and academic concern regarding marketing students' quantitative skills (Ganesh et al., 2010).

Furthermore, marketing educators have long discussed the value of developing critical thinking skills among students to better prepare them for marketing careers (Celuch & Slama, 1998, 2000, 2002, 2008). Celuch and Slama (2000) noted that critical thinking is "associated with moving beyond focusing on content to an awareness and appreciation of the process of how one is thinking about content" (p. 57). A number of researchers have discussed methods to leverage critical thinking pedagogies in the marketing curriculum (e.g., Diamond, 2008; Krentler, Hampton, & Martin, 1994; Lunsford, 1990). With the exception of Diamond (2008), researchers have concentrated on non-quantitative topics. Little research has focused on preparing students to think more critically about mathematical concepts. In this study, we help to fill this gap by exploring a holistic perspective of developing knowledge of mathematical concepts. We build our study on the foundation of procedural and conceptual knowledge. Procedural and conceptual knowledge are established concepts within the field of mathematics education, and educators frequently use these concepts to examine and develop problem solving and quantitative skills among students (see Carpenter, 1986; Eisenhart et al., 1993; Rittle-Johnson & Alibali, 1999; Skemp, 1976).

PROCEDURAL AND CONCEPTUAL KNOWLEDGE

Various definitions exist of procedural and conceptual knowledge. For example, Hiebert and LeFevre (1986) defined procedural knowledge as a series of actions executed in a specific manner and conceptual knowledge as a system of relationships between pieces of information, which provides flexibility in retrieving and using the information. These details have been instrumental in research on mathematics teaching and learning and have been described and supported by many researchers in the field of mathematics (Carpenter, 1986; Greeno, 1980; Skemp, 1976).

Conceptual learning shares several traits with deep learning and critical thinking, including better understanding of concepts and applying knowledge of concepts to new situations. Marton & Säljö proposed that deep learning is both a process and an outcome. In deep learning, students work towards a comprehension of material that goes beyond superficial rote learning and searches for additional meaning of concepts (1976). Celuch & Slama's work on critical thinking (2002) also supports the conceptual viewpoint of learning and understanding mathematics concepts. As they wrote, "It [critical thinking] is not just a matter of memorizing a few facts or of engaging in an easily performed behavior. It is a set of skills that requires development, practice and commitment to perform well" (p. 14).

Research suggests that students typically achieve higher levels of procedural knowledge than conceptual knowledge. Englebrecht, Bergsten, and Kagesten (2009) described cases in South Africa and Sweden, as well as other countries, where high school students entered college/university study with mostly procedural understandings of mathematics concepts. While it is acceptable to learn mathematics procedurally, one must also possess an understanding of mathematics in a conceptual manner so that he/she can connect pieces together to make sense of bigger concepts or ideas. For example, when asked "What is the area of a field 20 centimeters by 15 yards?," a student with procedural understanding is likely to use the formula to easily calculate the area (length X width) but may have trouble ascertaining the units of the area of the field (Skemp, 1976). However, if the student has both procedural and conceptual understanding he/she should be able to use the formula and understand the concept of area to correctly identify common units.

Furthermore, research suggests that students with sound conceptual understanding have better procedural skills and are able to adapt existing procedures to novel contexts (Rittle-Johnson & Alibali, 1999). However, if the student lacks conceptual understanding, he/she may be able to solve familiar textbook problems correctly but is likely to fail to reconstruct the procedures in new/different contexts. Furthermore, conceptual knowledge corresponds with critical thinking as both imply an awareness of how one thinks of concepts/content (Celuch & Slama, 2002; Mahir, 2009).Therefore, sound understanding of both procedures and concepts build critical thinking and problem solving skills that are important to succeed in a dynamic business environment (Carpenter, 1986; Celuch & Slama, 2002; Krentler, 1994).

Tall and Razali (1993) have studied difficulties in mathematics understanding and performance of students who succeed and students who fail. They have found that stronger, more able students (above average) are better at internalizing learned procedures into conceptual knowledge. In addition, they are better positioned to see relationships and connections between concepts (Gray & Tall, 1991; Tall & Razali, 1993). On the other hand, weaker students often go through procedures and operate on them as separate pieces of data, causing greater cognitive strain and increasing the probability of failure or lower performance (Gray & Tall, 1991; Tall & Razali, 1993). Instruction focused on procedures and methods alone cannot prepare retail students to work with and solve real problems; students also need to learn to develop connections, relationships, and tools to help them think more deeply about concepts.

METHODOLOGY

Experimental Design and Stimuli

This research is guided by previous studies that focused on procedural and conceptual understanding of mathematics and how students perceive their own understanding of mathematics (Eisenhart et al., 1993; Engelbrecht et al., 2009; Galbraith & Haines, 2000; Rittle-Johnson & Alibali, 1999). In addition, we were interested to know how students received the instructional process and how their perceptions could guide adjustments or revisions to retail mathematics coursework in programs. A single-factor (Instructional Approach: conceptual vs. procedural) between-subjects experiment was used, wherein the instructional approach was manipulated using short embedded instructional videos presented by the author with expertise in mathematics education. Twenty innovative instructional videos were produced that corresponded to ten simple arithmetic problems (Betz & Hackett, 1983); two videos were created for each mathematics problem – one presenting a procedural approach and the other a conceptual approach to solving the problem. Each video was three to four minutes long. In the procedural videos, the presenter demonstrated how to solve the corresponding problem using arithmetic procedures and equations. For example, in the case of a simple addition problem, a video for procedural instruction would focus on the "process of adding two numbers," whereas a video for conceptual instruction would focus on the "concept of sum."

The mathematics problems presented on the videos were adapted from the Mathematical Self-Efficacy (MSE) Scale by Betz & Hackett (1983). Specifically, the MSE scale contains 75 items, 18 representing mathematics problems, 30 representing mathematics tasks, and 27 representing college courses (Betz & Hackett, 1983). Because retail mathematics is based on basic mathematical concepts such as percentages and fractions, our focus was to examine student ability to solve basic mathematics problems. Therefore, we chose to use the mathematical problems of the MSE scale. However, we used only ten problems that were directly related to a working knowledge of basic arithmetic concepts (e.g., fractions and percentages) and relevant to retail mathematics. For example, we chose not to use the following problem due to lack of relevance to the retail context - "The opposite angles of a parallelogram are ____." Table 1 lists the ten mathematical problems that were used, and the appendix provides textual representations of two of the instructional videos.

Table 1. Set of mathematical problems used in experimental stimuli

PROBLEM	OPTIONS			
	A	B	C	D
1) There are three numbers. The second is twice the first, and the first is one-third of the other number. Their sum is 48. Find the largest number.	8	16	20	24
2) In a certain triangle, the shortest side is 6 in., the longest side is twice as long as the shortest side, and the third side is 3.4 in. shorter than the longest side. What is the sum of the three sides in inches?	21.4	25	26.6	27.4
3) Bridget buys a packet containing 9-cent and 13-cent stamps for \$2.65. If there are 25 stamps in the packet, how many are 13-cent stamps?	5	10	15	20
4) Which of the following equations expresses the condition that "the product of two numbers R and S is one less than twice their sum"?	2(R x S)-1 = R + S	R x S = 2(R + S)-1	R x S = (R + S) +1	R x S-1 = 2(R+S)
5) If 3x - 2 = 16 - 6x, what does x equal?	1.5	2	4.67	8
6) Fred's bill for some household supplies was \$13.64. If he paid for the items with a \$20, how much change should he receive?	6.36	7.56	7.64	13.44

7) On a certain map, $^7/_8$ in. represents 200 miles. How far apart are two towns whose distance apart on the map is $3^1/_2$ in.?	600 miles	650 miles	700 miles	800 miles
8) The formula for converting temperature from degrees Centigrade to degrees Fahrenheit is F = $^9/_5$ C +32. A temperature of 20 degree Centigrade is how many degrees Fahrenheit?	0	32	46	68
9) Set up the problem to be done to find the number asked for in the expression “six less than twice 4%?”	(2x4)-6	(2x.04)-6	2(.4-6)	(2x.4)-6
10) A living room set consisting of one sofa and one chair is priced at $200. If the price of the sofa is 50% more than the price of the chair, find the price of the sofa.	$100	$133	$120	$150

Sample and Procedure

Data was collected from a convenience sample of 65 students who had completed a three-credit introductory retail mathematics course in a regional public university (see Table 2). The primary objective of the course was to introduce students to retail mathematics concepts such as markdowns, markups, sales, inventory levels, margins, income statements, profit, expenses, and purchases. Participants were purposefully recruited from students who had completed the retail course since it had a pre-requisite of a general education mathematics course. Completion of the general education mathematics course ensured that they had a working knowledge of arithmetic concepts such as fractions and percentages, knowledge which was important for this study.

Table 2. Student characteristics

Characteristic	Category	*f*	%
Age	18 to 19	16	24.6
	20 to 21	25	38.5
	22 to 25	20	30.8
	26 or older	4	6.2
Gender	Female	59	90.8
	Male	6	9.2
Ethnicity	Caucasian	17	38.6
	African American	22	50.0
	Asian	3	6.8
	Undisclosed	23	35.4
Year	Freshman	1	1.5
	Sophomore	18	27.7
	Junior	18	27.7
	Senior	28	43.1

Students were recruited via class announcements and an invitation email sent by the researcher. The invitation email included a link to the online information page, which provided a description of the study and a consent statement. If the student decided to participate, s/he clicked on a link to proceed to the questionnaire. First, as an initial assessment, we measured student’s preference for conceptual and procedural approach by demonstrating conceptual and procedural processes to solve a mathematical problem (via a short embedded video in the questionnaire). After presenting both approaches, we asked the students to evaluate each approach on a five-point semantic differential scale (1 = Poor, 2 = Fair, 3 = Good, 4 =Very Good, 5= Excellent).

Students were then randomly assigned to the procedural or conceptual condition. Specifically, they were asked to solve ten mathematical problems (Mathematical Self-Efficacy Scale by Betz & Hackett, 1983), and as each problem was presented, the answer was checked for accuracy. If students were unable to solve the problem correctly, they were given additional instructions through a short embedded video in the questionnaire. Depending on the random assignment, each time students failed to solve a problem correctly, they received only one form of additional instruction - procedural or conceptual. After each instructional video, we asked the students to evaluate the instructional approach on a five-point semantic differential scale (1 = Poor, 2 = Fair, 3 = Good, 4 =Very Good, 5= Excellent). Students were then directed to the next problem. This process was repeated until the students had attempted all problems. Finally, participants completed demographic items and were thanked for their participation.

RESULTS

Comparing approaches – procedural versus conceptual

When students were first introduced to conceptual and procedural approaches, they rated the procedural approach (M = 3.66, SD = 1.11) significantly higher than the conceptual approach (M = 2.94, SD= 1.30); t

(64) = 3.43, p = .000. Additionally, when students were given a set of problems and were given additional instructions when they were unable to solve a problem, the group presented with the procedural approach (M = 3.65, SD = .68) rated the instruction significantly higher than did the group provided with the conceptual approach (M = 3.12, SD = 1.00); t (58) = 2.48, p = .008. Further, the average score for the group with conceptual instruction (M = 4.71, SD = 1.71) was slightly higher than for the group with procedural instruction (M = 4.60, SD = 1.69), but the difference was not significant; t (62) = -0.27, p = .39.

Comparing approaches - above average and average/below average groups

Based on the average score for the set of problems, we used the mean split method to divide the sample into two groups – above-average (M_{score} = 6.68; n = 19) and average/below-average (M_{score} = 3.83; n = 46). When students were first introduced to both conceptual and procedural approaches, the above-average group rated the procedural approach (M = 4.22, SD = 0.97) more positively than the conceptual approach (M = 2.84, SD = 1.51); t (18) = 3.56. p =.001. Similarly, the average/below-average group also rated the procedural approach (M = 3.43, SD = 1.13) more positively than the conceptual approach (M = 2.98, SD = 1.32); t (45) = 3.56, p = .03.

If they were unable to solve a problem and were presented with additional instruction, the above-average group rated the procedural approach (M = 4.00; SD = 0.75) more positively than the conceptual approach (M = 3.53; SD = 0.87), but the difference was not significant; t (17) = 1.44, p = 0.08. The average/below-average group rated the procedural approach (M = 3.50, SD = 0.60) significantly more positively than the conceptual approach (M = 2.98, SD= 1.02); t (40) = 2.14, p = .02.

Comparing preference for an approach - before & after solving problems

Interestingly, when we compared participants' ratings of the assigned instructional approach before and after they worked on the set of ten problems, the above-average group assigned to conceptual instruction rated the instruction significantly more positively after working on the problems (M = 3.53, SD = .86) than they did the first time they were introduced to the conceptual approach (M = 2.60, SD = 1.51); t (9) = -2.19, p = .02. On the other hand, the above-average group assigned to procedural instruction rated the instruction less positively after working on the problems (M = 4.00, SD = .75) than they did before working on the problems (M = 4.22, SD = 0.97), but the difference was not significant; t (8) = 1.07, p = .15. Similarly, the average/below average group assigned to procedural instruction rated the instruction slightly lower after working on the problems (M = 3.50, SD = 0.60) than they did when they were first introduced to the procedural approach (M = 3.52, SD = 1.71); t (20) = 0.12, p = .45. On the contrary, the average/below average group assigned to conceptual instruction rated the instruction more positively after working on the problems (M = 2.98, SD = 1.02) than they did when they were first introduced to the conceptual approach (M = 2.92, SD = 1.50) and; t (24) = -0.17, p = .43.

Table 3. T-test results comparing procedural and conceptual instructional approaches; and preference for an approach before/after working the problems

	Procedural Instruction		**Conceptual Instruction**		**t-test**
	M	**SD**	**M**	**SD**	
Entire Group					
Before working the problems	3.73	1.11	2.82	1.30	3.43**
After working the problems	3.65	0.68	3.12	1.00	2.48*
t-test	0.30		-0.99		
Above-average group					
Before working the problems	4.22	0.97	2.84	1.51	3.56**
After working the problems	4.00	0.75	3.53	0.86	1.44
t-test	1.07		-2.19*		
Average/below-average group					
Before working the problems	3.52	1.71	2.97	1.50	1.86*
After working the problems	3.50	0.60	2.98	1.02	2.14*
t-test	0.12		-0.17		

Note. ** p <0.001;* p <0.05.

DISCUSSION

In summary, we found that students (above-average and average/below-average) preferred the procedural approach over the conceptual approach. The procedural approach was the preferred approach in both scenarios: a) when students were first introduced to the two problem solving approaches (procedural and conceptual), and b) when they were unable to solve a problem and were presented with additional instruction. This finding indicates that students prefer the procedural or formula-driven approach to mathematics. This preference may partly be due to the ease of remembering formulas as compared to understanding concepts. Additionally, one can get to the right answer very quickly with formulas (Skemp, 1976).

Interestingly, when above-average students were first introduced to the two approaches and instruction after solving mathematical problems, they rated the conceptual approach significantly higher after they were unable to solve a problem and were presented with additional conceptual instruction. On the other hand, their rating of the procedural approach decreased when they were unable to solve a problem and were presented with additional procedural instruction. Assuming that students with above-average scores are comfortable with simple mathematical problems, this finding indicates that only when students have some level of comfort in solving mathematical problems and are unable to solve a specific problem, they shift preference from formulas to concepts. This shift may be partly due to the fact that a set of formulas did not help them understand and solve the problem correctly, so they were motivated to move beyond “rules without reasons” and really want to know “what the numbers mean and why.” This finding is in line with Mahir’s (2009) assertion of the importance of conceptual understanding in learning calculus. Furthermore, as noted by a stream of mathematics literature, sound conceptual knowledge can be more easily transferred to new contexts and also supports advancement of procedural knowledge (Carpenter, 1986; Rittle-Johnson & Alibali, 1999; Gray & Tall, 1991; Tall & Razali, 1993). In other words, once students understand a concept, they can use the formula-driven approach more effectively to quickly solve problems in different contexts (Carpenter, 1986; Gray & Tall, 1991; Tall & Razali, 1993). However, concentrating on procedural learning alone can lead to long-term failure in understanding and applying mathematical concepts across scenarios (Gray & Tall, 1991; Tall & Razali, 1993).

Implications

The overall outcome of this study indicates that students studying retail mathematics have a very strong inclination towards procedures; but while procedural knowledge is important, it does not always transfer into understanding applications involving computations. This finding offers several implications. First and most importantly, students studying retail mathematics and other courses involving mathematics must understand that there are routine procedural approaches but that these differ from true conceptual understanding. Once students recognize such differences and the importance of both in the workplace, they may be more inclined to develop both procedural and conceptual understanding of mathematics concepts. In order to facilitate this realization, instructors should find ways to introduce learning situations where students can build strength in both procedural and conceptual understanding and be informed about this understanding.

Secondly, instructors must provide more contextual scenarios for students to engage in retail mathematics. Some students learn formulae but do not have the ability to apply them to real-life situations to help make sense of retail or other practical situations. The purpose of learning mathematics in retail coursework is to relate it to the workplace environment in order to have a successful business. The findings of this study suggest that with a solid procedural understanding, students are better positioned to connect the information to a conceptual perspective, which in turn gives a more complete picture of the problem. Therefore, it can be beneficial to approach retail mathematics from both procedural and conceptual perspectives. For example, in addition to teaching procedures and equations, instructors can integrate creative methods of teaching concepts. Flynn and Sandberg (1993) also recommend integrating theory and practice to enhance student understanding of retail mathematics concepts. For instance, students could be assigned hands-on projects/simulations where they have to run a retail store and make business decisions involving retail mathematics (e.g., markdowns, markups, sales, inventory levels, margins, income statements, profit, expenses, and purchases)

This study also brought forth the importance of collaboration between educators in two different areas of expertise. The researchers in this study were a business educator and a mathematics educator. By forming a partnership, the business educator became better informed about procedural and conceptual understanding of mathematics and ways that she could improve her classroom instruction for future students. In addition, the mathematics educator was able to study how the retail field uses simple mathematics concepts and identify some of the challenges that the workplace faces. This collaboration reinforced the relevance of engaging in cross-disciplinary discourse to improve pedagogy for the benefit of all students (Flynn & Sandberg, 1993).

LIMITATIONS

This study is not without limitations. First, this study was set within the context of a retail mathematics course and only one section per semester was offered in an academic cycle, so our sample size was limited. Second, we used Betz and Hackett’s (1983) self-efficacy scale, which is an established measurement for mathematics confidence but limited in that some of the measurement items were not related to the domain of retail. Regardless, they were relevant to basic mathematics tasks.

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APPENDIX

The two problems that follow provide insight into the different approaches that will be taken for working through the mathematics problems in this study. The first approach is procedural – focused more on formulas and algorithms to solve problems. The second approach is conceptual – focused more on understanding the problem and how one can get to a solution with or without a formula. These approaches were presented to the participants in the form of a short video-clip.

PROBLEM 3: Bridget buys a packet containing 9-cent and 13-cent stamps for $2.65. If there are 25 stamps in the packet, how many are 13-cent stamps?

Procedural presentation:
This problem can be solved by using a system of equations:
9x+13y=2.65
x + y =25
When working with a system of equations, solve for one variable and then substitute into one of the equations to find the second unknown.
Let x be the number of 9-cent stamps and y be the number of 13-cent stamps

.09x + .13y = 2.65	x + y = 25
-.09x + -.09y = -2.25	x + 10 = 25
.04y = 0.4	$\boxed{x = 15}$
$\boxed{y = 10}$	

Therefore, Bridget has **10** 13-cent stamps.

Conceptual/visual presentation:
Bridget has a pack of stamps with two separate groupings: 9-cents and 13-cents. Both groups total 25 stamps. Let's organize the data and look at it from a visual perspective.
Make a table that has columns of 9-cents, 13-cents, total cost, and total number of stamps to search for patterns in the data:

Number 9-cent stamps	Number 13-cent stamps	Total cost	Total number of stamps
1	24	3.21	25
2	23	3.17	25
3	22	3.13	25
4	21	3.09	25
5	20	3.05	25
6	19	3.01	25
7	18	2.97	25
8	17	2.93	25
9	16	2.89	25
10	15	2.85	25
11	14	2.81	25
12	13	2.77	25
13	12	2.73	25
14	11	2.69	25
15	**10**	**2.65**	**25**
16	9	2.61	25
17	8	2.57	25

Studying the data for trends and patterns, one can see early on that the totals decrease by 4-cents and that there must always be 25 stamps together. The table can be extended or one can talk about what they observe and figure it out from there.

Therefore, Bridget has **10** 13-cent stamps.

PROBLEM 10: A living room set consisting on one sofa and one chair is priced at $200. If the price of the sofa is 50% more than the price of the chair, find the price of the sofa.

Procedural presentation:
Using equations & percents, one can determine the price of the sofa:
s = sofa; c = chair
s = c + (50% of c)
Price = c + s OR 200 = c + s
200 = c + (c + .50c)
200 = 2c + .50c
200 = 2.50c
80 = c
Since chair is $80, that prices the sofa at $120 (because together they add to $200)

Conceptual/visual presentation:
We know we have a chair and a sofa that are priced together at $200. We need to find the price of the sofa. The sofa price is based on the chair price, but we don't know the chair price. What we do know is that whatever the chair costs, the sofa is that amount + 50% more (1/2 more). Build a table of values and look for a pattern in the data that can help in finding the sofa price.

Chair price	Sofa price	Total price
200	200+100	500
100	100+50	250
50	50+25	125

The data shows the price of the chair is between 50 and 100 – should observe that it is closer to 100. We will use the same strategy to build other values in the table. Going by "10's" appears to be a good strategy to use.

Chair price	Sofa price	Total price
90	90+45	225
80	**80+40**	**200**

We see that when the chair is priced at $80, the sofa is priced at $120, which gives a total price of $200. We have answered the problem.