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Learning Preferences Diagnostic using Mathematical Theory of Evidence

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Abstract: The purpose of this study is to determine the various degrees of learning preferences in order to define various learning styles that are applicable to different kinds of people. To determine an individual's preference levels, a measurement scale based on ordinal scale has been utilised. Very rarely, average level, and very regularly are the three primary subcategories that make up this scale's subdivisions. The development of a numerical hypothesis can be aided by employing the measuring scale on an ordinal scale. This numerical hypothesis can then be used to establish an individual's preferred method of learning by applying the mathematical theory of evidence. The research utilised twenty-four different question sets to support a particular individual's preferred method of learning, and it utilised the data that was offered to do so. It did so by filtering it using several degrees of probability of the evidence theory model, all of which helped in proving or supporting a certain hypothesis. The conclusion is that by applying the mathematical theory of evidence, we are able to easily diagnose the preferred method of learning for every given individual.

Keywords: Mathematical Theory of Evidence; Question Sets; Learning Preferences; Collaborative Assignments; Deliberated Solutions; Dependent Learners; Standard Algorithm.

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1. Introduction

The research determines various learning preferences under physiological or perceptual dimensions. By first defining the three main learning preferences developed by Reichmann & Grasha [4] and describing how they are closely related to Sadler-Smith's learning preference factors, the research can lay a solid foundation for understanding how to apply various probabilities inferences to determine a learner's preference [3]. When it comes to learning styles, it can be worthwhile to first define the learning preferences various authors use to analyze the literature [10]. Learning preferences can be defined as an individual's choice or inclination toward certain learning practices, more so than toward others. Three learning preferences were identified by Reichmann and Grasha [4].

The first – Dependent Learners – refers to those individuals who favor well-planned methods with clearly defined tasks and high levels of tutor involvement. The second – Collaborative Learners – refers to individuals who prefer group learning practices. They are inclined towards collaborative assignments and deliberated solutions. The third – Independent Learners – favor an approach that offers some level of power and control over what they learn and how it is delivered to them. For these individuals, the tutor is considered to be a resource. Sadler-Smith designed an inventory of learning approaches after conducting a factor analysis of the various items in the inventory and deliberating with students and staff members of the educational

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institution. Sadler-Smith suggested factors behind the various learning preferences that closely correlated with the learning styles used by Reichmann and Grasha [4].

Several studies related to learning preferences have been conducted. Onyejegbu & Asor [18] studied the Naïve Bayes classifier multinomial model for detecting learning style preferences in a personalized e-learning management system. Ernst [9] identified learner preferences of high school student participants and examined learner preference differences among at-risk students and students not categorized as at-risk. Statistical evaluation and analysis identified common learner preferences among at-risk and not at-risk participants. Lee & Sidhu [21] investigated the learning style preference of mechanical engineering students using personality and learning style instruments. A descriptive statistical method was used to analyze the collected samples. Demirel [6] determined university students' learning preferences and analysis by several variables. The survey method was used in this research.

Meyer et al. [19] studied VARK learning preferences and mobile anatomy software application use in pre-clinical chiropractic students. The standard algorithm was used to interpret the study data. In research, Klement [15] analyzed Williams et al. [14] investigated the learning style preferences of undergraduate pharmacy students enrolled at one Australian university. The analysis was performed by calculating the frequency of occurrence of a particular learning style preference according to the VARK classification and supplemented with additional information, which aimed to illustrate the age distribution within particular groups of respondents in connection with learning style preferences. This research used a mathematical theory of evidence, which provides a rule to combine pieces of evidence from independent observers into a single and more informative hint. Evidence theory is based on belief function and plausible reasoning.

2. Learning Preferences

Here, you can specify whether you want to cater to a "Auditory learner," "Visual learner," or "Kinaesthetic learner," depending on how the user prefers to absorb information. A Virtual Learning Environment (VLE) will use the information gathered in this section to decide what form the supplied content should take (i.e., an interactive movie, a video clip, an audio clip, text, or a combination of all of these) [10]. This data could also be helpful to a teacher when organising a lesson or evaluating a student, providing some leeway for any difficulties the student may have had with the method of instruction used [1]. Visual learners need to see, observe, record, and write. They tend to absorb information best through seeing Images, Charts, Lists, and Videos [2]. They will find it easiest to understand meaning through visual linearization and interpretative illustration. This type of user interprets content best by reading or through written descriptions. When thinking about possibilities, the visual learner works effectively with brainstorming exercises, such as webbing and mind mapping [10]. Auditory learner learners need to talk and to listen. They will understand by listening and responding to information. For example, they will develop meaning by holding a dialogue and discussing a subject [22].

Auditory learners typically interpret content best by listening (e.g., to a lecture) and engaging in debate [10]. When thinking of possibilities, the auditory learner prefers to discuss ideas, interests, and problems. Tactile-kinaesthetic learners need to move, do for themselves, touch, and be physically involved [23]. They need structured, hands-on activities, such as creating models (e.g., a replica of a building) or designing (e.g., music or software) [10]. Kinaesthetic users gain meaning by being involved in activities. They typically need to touch and interact with what is being discussed, for example, by holding and examining a model. They will typically see possibilities by immersing themselves in trial-and-error experimentation, such as designing and creating a solution [5]. The levels of a person's preferences have been calculated using an ordinal scale [24]. Ordinal measurement scale is depicted in Figure 1. Very rarely, typically, and frequently are the three broad categories that make up the scale. The ordinal scale allows us to generate a numeric hypothesis that may be used to test the mathematical theory of evidence and uncover an individual's preferred method of learning.

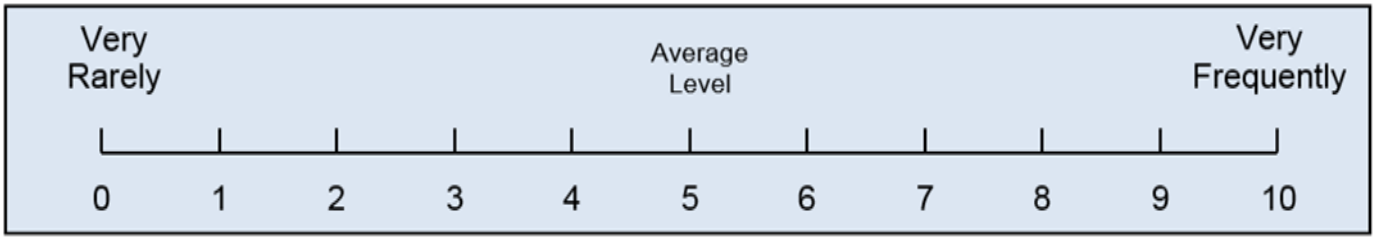


Figure 1: The scale of learning preferences measurement in ordinal scale

Table 1 explains learning preferences using various physiological and perceptual dimensions.

Table 1: Learning Preference

No.	Learning Preference: Physiological/Perceptual Dimension Question Sets	Answer
1	For me, listening is much more effective than reading when it comes to retaining information.	Auditory learner, Visual learner {A, V}
2	When I go somewhere unfamiliar, I prefer to have written directions rather than vocal ones.	Auditory learner, Visual learner {A, V}
3	Writing or typing things out, or taking notes, helps me recall them better than just remembering them in my head.	Kinaesthetic {K}
4	When I'm writing something down or typing on the computer, I tend to use a heavy hand.	Kinaesthetic {K}
5	Diagrams, graphics, and other forms of visual learner directions need to be accompanied by thorough justifications before they can be useful to me.	Visual learner {V}
6	Working with development tools, whether they are real or digital, comes quite naturally to me.	Kinaesthetic {K}
7	I find that visual representations of problems and their implications greatly aid my comprehension of those problems.	Visual learner {V}
8	When presented with pairs of sounds, I know when the sounds match.	Auditory learner {A}
9	Writing/typing helps me to remember ideas and to think more clearly.	Kinaesthetic {K}
10	When I need to get to a new city or make my way around a strange area, I pull up a map on my phone or laptop.	Visual learner {V}
11	In my opinion, it is simpler to learn through auditory means, such as listening to CDs, MP3s, or file casts.	Auditory learner {A}
12	I like to fiddle with the pens, keys, and other items around me while I study.	Kinaesthetic {K}
13	I find that saying the words and letters out helps me remember them better.	Auditory learner {A}
14	Than keep up with current events, I prefer reading to listening to the radio or watching television.	Visual learner {V}
15	I absorb information best when I am actively engaged in making, fixing, or bettering something.	Kinaesthetic {K}
16	I can remember things best by visualizing something in my head.	Visual learner {V}
17	When I was a kid, I benefited most from practising my spelling and grammar by writing out sentences.	Kinaesthetic {K}
18	I find that listening to an engaging speaker is more informative than reading about the same topics in print or online.	Auditory learner, Visual learner {A, V}
19	Jigsaw puzzles and other mind games are fun and interesting activities for me.	Kinaesthetic {K}
20	I find it helpful to have something tangible to hang on to when studying.	Kinaesthetic {K}
21	I'd rather get my news via my phone, the radio, or the internet than from a printed newspaper or magazine.	Auditory learner, Visual learner {A, V}
22	When I want to learn more about a topic that piques my interest, I turn for resources like books, magazines, and the Internet.	Visual learner {V}
23	Physical contact is something with which I am completely at ease (handshake, embrace).	Kinaesthetic {K}
24	I have a better time remembering verbal instructions than written ones.	Auditory learner, Visual learner {A, V}

3. Mathematical Theory of Evidence

The Mathematical Theory of Evidence [12] is an area of mathematics concerned with the use of multiple pieces of empirical evidence to construct an accurate representation of an individual's mental processes. To put it another way, this theory makes use of mathematical inferences to arrive at grounded conclusions about the world [25-27]. A Mathematical Theory of Evidence, written by associate professor and author Glenn Shafer, is often cited as crucial in the development and dissemination of this theory. Nonetheless, his senior professor Arthur Dempster [12] was the inspiration for the theory [28]. The essential premise

of this theory is the requirement for developing reasoning based on facts that must be supported by real evidence in both the natural and applied sciences. This notion is supported by numerical data [11]. Probability, a branch of mathematics, is used extensively inside the framework to aid in the creation of numerous decision trees used as the evidence needed to prove a certain line of reasoning or truth [17]. Measurements of evidence and weighting the credibility of various pieces of evidence can be found in the mathematical theory of evidence [7]. Belief and plausibility, represented by the functions Bel() and Pls(), are used as measures of uncertainty in the mathematical theory of evidence. First, we must define a finite set called a frame of discernment, indicated by the sign Θ. A discerning framework is a complete and mutually exclusive set of hypotheses [28-31] . The sign 2^{Θ} indicates the set composed of all the subsets generated by the frame of discernment. Any subset of Θ is also a hypothesis. A minimal level of confidence in the set of hypotheses is represented by m: $2^{\Theta} \rightarrow [0,1]$ [40].

$$m\ (\emptyset) = 0 \tag{1}$$

$$\sum_{A \subseteq \Theta} m\ (A) = 1 \tag{2}$$

Based on mass distribution, a belief function(Bel), corresponding to the minimum uncertainty value about the hypothesis, is defined as the following:

$$Bel\ (A) = \sum_{A_i \subseteq A} m\ (A_i) \tag{3}$$

Belief in the object's location, as measured by Bel (A). A belief function quantifies how much credence one has in each element of. Alternatively, m(A) is the conviction that applies exclusively to set A [32].

A plausibility function (Pls) corresponding to the maximum uncertainty value is defined as the following:

$$Pls(A) = \sum_{A_i \cap A \neq 0} m(A_i) \tag{4}$$

Lower and higher probability functions describe the connection between the credibility of set A and the credibility of set B, respectively A, A υ $\bar{A}$ = The plausibility Pls (A) is defined as the degree to which the evidence fails to refute A [33].

Pls (A) = 1 – Bel ($\bar{A}$)

(5)

$$Pls(A) = 1 - \sum_{A_i \subseteq \bar{A}} m\ (A_i) \tag{6}$$

Bel (A) ≤ Pls (A) (7)

Pls (A) measures the total belief that can move into A. The measures are related to each other.

The mathematical theory of evidence provides a framework for integrating several measures of evidence. Independent sources are assumed for the sake of the theory of evidence [40]. Dempster's rule of combination is used to define the combination [8]: m = m1 ⊕ m2, also called orthogonal sum [34].

$$(m_1 \oplus m_2)\ (\emptyset) = 0 \tag{8}$$

$$m_1 \oplus m_2(A) = \frac{1}{1-R} \sum_{A_i \cap A_j = A} m_1\ (A_i)\ m_2(A_j) \tag{9}$$

Where

$$R = \sum_{A_i \cap A_j = \emptyset} m_1(A_i)\ m_2(A_j) \tag{10}$$

$$m(A), m_1(A_i), m_2(A_j) \rightarrow [0,1],\ A \neq \emptyset \tag{11}$$

∅ is the sign of an empty set. The function m is known as the degree of belief, and m (A) represents the proportion of individuals that belong to group A Θ. The mathematical theory of evidence combines two independent sets of mass assignments [35].

4. Implementation

The mathematical theory of evidence can today be applied to help determine the learning preference of an individual by applying various mathematical tools, such as probability, to help come up with enough evidence necessary to support a given learning preference [16]. This means that the evidence presented to support a given learning preference for a specific individual is often filtered using various degrees of probabilities, which may help to prove or validate a particular hypothesis. In other words, the mathematical theory of evidence is used to develop an individual's decision analysis, which helps determine their learning preference method [36]. The student filled in a scale of measurement in ordinal scale and was converted to a degree of belief. The data presented in this article show the responses of Higher Education students completing a questionnaire about their learning preferences [20]. Table 2 shows the learning preference degree of belief [37-39].

Table 2: Learning Preference Degree of Belief

No.	Learning Preference: Physiological/Perceptual Dimension Questions Sets	Test 1	Test 2
1	I can remember more about a subject through listening than by reading about it.	0.9	0.7
2	When I go somewhere unfamiliar, I prefer to have written directions rather than vocal ones.	0.6	0.9
3	I can best remember important facts and ideas if I write or type them out or take notes.	0.5	0.6
4	When I'm writing something down or typing on the computer, I tend to use a heavy hand.	0.2	0.5
5	Diagrams, graphics, and other forms of visual learner directions need to be accompanied by thorough justifications before they can be useful to me.	0.6	0.8
6	Whether they are real or digital, working with development tools is something that comes quite naturally to me.	0.7	0.9
7	I find that visual representations of problems and their implications greatly aid my comprehension of those problems.	0.5	0.6
8	If you show me a pair of sounds and ask me if they go together, I can tell you when they do.	0.5	0.5
9	I find that when I put my thoughts down on paper on a computer screen, I am better able to remember them and to organise them.	0.8	0.2
10	When I need to get to a new city or figure out how to get there, I use online maps.	0.6	0.6
11	In my opinion, it is simpler to learn through auditory means, such as listening to CDs, MP3s, or file casts.	0.7	0.7
12	I like to fiddle with the pens, keys, and other items around me while I study.	0.8	0.5
13	I find that saying the words and letters out helps me remember them better.	0.7	0.4
14	I'd rather read a book than listen to the radio or watch TV to be abreast of current events.	0.5	0.8
15	Making, fixing, and enhancing things is where I absorb information the most.	0.7	0.6
16	Creating an image in my mind helps me retain information.	0.5	0.2
17	Writing words out on paper was the best way for me to acquire correct spelling and grammar when I was a kid.	0.4	0.6
18	A excellent speaker is more informative to me than any book, magazine, or website I could ever hope to read.	0.8	0.7
19	Mind games like jigsaw puzzles are entertaining and interesting to me.	0.6	0.5
20	I find it helpful to have something tangible to hang on to when studying.	0.7	0.5
21	I'd rather get my news via my phone, the radio, or the internet than from a printed newspaper or magazine.	0.9	0.8
22	When I want to learn more about a topic that piques my interest, I turn for resources like books, magazines, and the Internet.	0.6	0.6
23	Physical contact is something with which I am completely at ease (handshake, embrace).	0.5	0.7
24	I have a better time remembering verbal instructions than written ones.	0.8	0.8

For example, refer to question number 24: "I seem to follow oral directions more easily than written ones." This statement says that the user's learning preferences are auditory and visual learners {A, V}. The student filling in the statement with a scale of 8 means the degree of belief m {A, V} = 0.8. A combination of the user's learning preference for question number 23 and the user's learning preference for question 24 is tabulated in Table 3 below.

Table 3: Combining learning preference answer

		{A, V}	**0.8**	**{Θ}**	**0.2**
{A,V}	**0.006**	{Ø}	0.005	{A,V}	0.001
{K}	**0.113**	{K}	0.09	{K}	0.023
{V}	**0.753**	{Ø}	0.602	{V}	0.151
{A}	**0.128**	{Ø}	0.102	{A}	0.026
{Θ}	**0.0000009**	{K}	0.0000007	{Θ}	0.0000002

We then calculate the combination of the user's learning preference for question number 23 and the user's learning preference for question number 24 in order to get a final degree of belief in the user's learning preference.

m{A,V} = 0.001/1 – (0.005+0.102+0.602) = 0.003, m_{47} {K} = 0.09+0.023+0.0000007/1 - (0.005+0.102+0.602) = 0.388
m{V} = 0.151/1 - (0.005+0.102+0.602) = 0.519, m_{47} {A} = 0.026/1 - (0.005+0.102+0.602) = 0.090
m{Θ} = 0.0000002/1 - (0.005+0.102+0.602) = 0.0000007

The final result is 0.519 > 0.388 > 0.090 > 0.003. Visual learner > Kinaesthetic >Auditory learner > Auditory learner, Visual learner. Regarding students having their learning preference as visual learners, they tend to grasp information best through seeing. They will find it easiest to understand meaning through visual learnerisation and interpretative illustration. Sometimes, individuals tend to have a collaborative preference, where a person can combine two learning preferences as his best learning technique [13].

5. Results and Discussion

Students' preferences for visual learning, auditory learning, and kinesthetic learning can be inferred with reasonable certainty from Tables 4 and 5 using the mathematical theory of evidence calculations obtained from the ordinal scale of measurement. There have been a number of research on learning styles, but none of them have taken into account the golden rule of condensing students' evidence into a single, more useful tip. Data on a single student is included in the table below; it includes a comparison of their learning preferences based on an ordinal scale of "very rarely," "average level," and "very regularly," as well as the probability of preference derived from mathematical theory of evidence calculations. To see this contrast, we'll make a scatter plot of the student's preferred degree level versus the twenty-four question sets. Table 4 displays the results of Test 1's learning preferences ranking. The final ranking shows Auditory learner, visual learner < Kinaesthetic, < Visual learner > Auditory learner. Table 5 shows the learning preferences rank of test 2. The Final ranking shows Auditory learner, visual learner < Kinaesthetic, < Visual learner > Auditory learner.

Table 4: Learning preferences rank of test 1

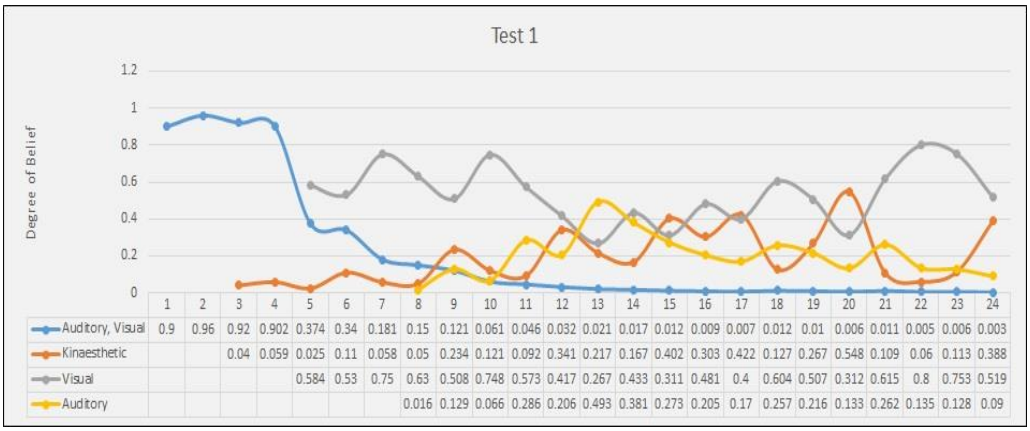
No	Auditory learner, Visual learner		Kinaesthetic		Visual learner		Auditory learner
1	Auditory learner, Visual learner	>	null	=	null	=	null
2	Auditory learner, Visual learner	>	null	=	null	=	null
3	Auditory learner, Visual learner	>	Kinaesthetic	>	null	=	null
4	Auditory learner, Visual learner	>	Kinaesthetic	>	null	=	null
5	Auditory learner, Visual learner	>	Kinaesthetic	<	Visual learner	>	null
6	Auditory learner, Visual learner	>	Kinaesthetic	<	Visual learner	>	null
7	Auditory learner, Visual learner	>	Kinaesthetic	<	Visual learner	>	null
8	Auditory learner, Visual learner	>	Kinaesthetic	<	Visual learner	>	Auditory learner
9	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
10	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
11	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
12	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
13	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	<	Auditory learner
14	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
15	Auditory learner, Visual learner	<	Kinaesthetic	>	Visual learner	>	Auditory learner
16	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
17	Auditory learner, Visual learner	<	Kinaesthetic	>	Visual learner	>	Auditory learner
18	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
19	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner

20	Auditory learner, Visual learner	<	Kinaesthetic	>	Visual learner	>	Auditory learner
21	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
22	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
23	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
24	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner

Table 5: Learning preferences rank of test 2

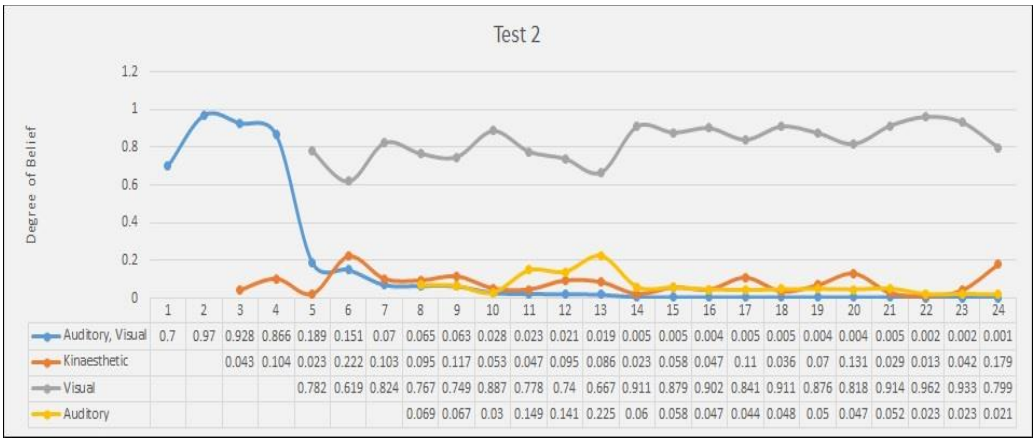
No	Auditory learner, Visual learner		Kinaesthetic		Visual learner		Auditory learner
1	Auditory learner, Visual learner	>	null	=	null	=	null
2	Auditory learner, Visual learner	>	null	=	null	=	null
3	Auditory learner, Visual learner	>	Kinaesthetic	>	null	=	null
4	Auditory learner, Visual learner	>	Kinaesthetic	>	null	=	null
5	Auditory learner, Visual learner	>	Kinaesthetic	<	Visual learner	>	null
6	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	null
7	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	null
8	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
9	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
10	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
11	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
12	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
13	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
14	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
15	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner		Auditory learner
16	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
17	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
18	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
19	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
20	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
21	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
22	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
23	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner
24	Auditory learner, Visual learner	<	Kinaesthetic	<	Visual learner	>	Auditory learner

Figure 2 shows the degree of belief progress during the first test. From the 24th calculation, we get Auditory and Visual 3%, Kinaesthetic 38.8%, Visual 51.9%, and Auditory 9%. Figure 3 shows the degree of belief progress during the second test. From the 24th calculation, we get Auditory, Visual 1%, Kinaesthetic 17.9%, Visual 79.9%, Auditory 2.1% [40].



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Auditory, Visual	0.9	0.96	0.92	0.902	0.374	0.34	0.181	0.15	0.121	0.061	0.046	0.032	0.021	0.017	0.012	0.009	0.007	0.012	0.01	0.006	0.011	0.005	0.006	0.003
Kinaesthetic			0.04	0.059	0.025	0.11	0.058	0.05	0.234	0.121	0.092	0.341	0.217	0.167	0.402	0.303	0.422	0.127	0.267	0.548	0.109	0.06	0.113	0.388
Visual					0.584	0.53	0.75	0.63	0.508	0.748	0.573	0.417	0.267	0.433	0.311	0.481	0.4	0.604	0.507	0.312	0.615	0.8	0.753	0.519
Auditory								0.016	0.129	0.066	0.286	0.206	0.493	0.381	0.273	0.205	0.17	0.257	0.216	0.133	0.262	0.135	0.128	0.09

Figure 2: Test 1 of learning preferences



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Auditory, Visual	0.7	0.97	0.928	0.866	0.189	0.151	0.07	0.065	0.063	0.028	0.023	0.021	0.019	0.005	0.005	0.004	0.005	0.005	0.004	0.004	0.005	0.002	0.002	0.001
Kinaesthetic			0.043	0.104	0.023	0.222	0.103	0.095	0.117	0.053	0.047	0.095	0.086	0.023	0.058	0.047	0.11	0.036	0.07	0.131	0.029	0.013	0.042	0.179
Visual					0.782	0.619	0.824	0.767	0.749	0.887	0.778	0.74	0.667	0.911	0.879	0.902	0.841	0.911	0.876	0.818	0.914	0.962	0.933	0.799
Auditory								0.069	0.067	0.03	0.149	0.141	0.225	0.06	0.058	0.047	0.044	0.048	0.05	0.047	0.052	0.023	0.023	0.021

Figure 3: Test 2 of learning preferences

From the preceding, we can conclude that learning preferences are an individual's choice or inclination towards certain learning practices over others. For instance, research has identified three main categories of learning preference based on Reichmann and Grasha [4], where individuals who favor well-planned methods with clearly defined tasks and a high level of tutor involvement are referred to as dependent learners. In contrast, individuals who prefer group learning practices or are inclined towards collaborative assignments and deliberated solutions are called collaborative learners. Finally, individuals who favor an approach that offers some level of power and control over what they learn and how it is delivered to them are independent learners. This research has identified Visual learner learners as individuals who need to see, observe, record, write, and tend to absorb information best through seeing images, charts, lists, and videos.

On the other hand, auditory learner learners need to talk, listen, and understand best by listening and responding to information. Finally, Tactile-kinaesthetic learners need to move, do for themselves, touch, and be physically involved. They need structured, hands-on activities, such as creating models or designing, and they gain meaning by participating in activities. In addition, this study concludes that the learning preference factors suggested by Sadler-Smith, where the user's learning preference is determined by establishing whether he/she is a 'Visual learner,' 'Auditory learner,' or 'Kinaesthetic' learner, correlate closely to the styles used by Reichmann & Grasha [4].

6. Conclusion

Reichmann and Grasha's learning preference and Sadler-learning Smith's factors are shown to be related in the mathematical theory of evidence. This theory attempts to use mathematical inferences to help come up with concrete reasoning about reality by using multiple pieces of empirical information together to produce the true picture of a person's thinking or judgement process. Facts and evidence must form the basis of our reasoning in the sciences and in the real world; the proof for this idea is numerical. These days, we may use the mathematical theory of evidence to figure out which learning methods people tend to choose by applying tools like probability to the problem of gathering the proof that's needed to establish a theory. To verify or confirm a hypothesis, it is common practise to apply a filter of probability to the information offered in favour of a certain learning preference for a given individual. In other words, a person's preferred approach to learning can be inferred from the results of a choice analysis that was informed by the mathematical theory of evidence. The hypothesis was tested with students in a study, and the results revealed that for him, visual learning was most effective and aural learning was least effective. There's also some consideration given to the idea that he might prefer a hybrid approach to learning. Using the graphical representation of the mathematical theory of evidence, the study finds that we may quickly diagnose a learner's choice.

Appendix A. Supplementary Material

The test 1 calculation process by the mathematical theory of evidence is as follows:

For me, listening is much more effective than reading when it comes to retaining information. According to this declaration, the user prefers to learn through both aural and visual means. {A, V}. If a student puts 9 in the blank, it indicates that they strongly believe the proposition m_1 {A, V} = 0.9.

1. When I go somewhere unfamiliar, I prefer to have written directions rather than vocal ones. According to this declaration, the user prefers to learn through both aural and visual means {A, V}. The student filling in the statement with 6 means degree of belief m_2 {A, V} = 0.6. In Table 1 below, we see the overlap between Learner Preference 1 and Learner Preference 2.

Table 1: Combining user's learning preferences 1 and 2

		{A, V}	**0.6**	**{Θ}**	**0.4**
{A,V}	**0.9**	{A,V}	0.54	{A,V}	0.36
{ Θ}	**0.1**	{A,V}	0.06	{Θ}	0.04

Next, we determine an updated level of confidence in learning preference 2 by combining the user's learning preferences 1 and 2.

m_3 {A,V} = 0.54 + 0.36 + 0.06/1-0 = 0.96, m_3 {Θ} = 0.04/1-0 = 0.04

2. Writing or typing things out, or taking notes, helps me recall them better than just remembering them in my head. The user is a kinaesthetic learner, according to this statement {K}. The student fills the statement with 5, which means the degree of belief m_4 {K} = 0.50. Table 2 below is a summary of the user's 2 and 3 learning preference combinations.

Table 2: Combining User's Learning Preferences 2 and 3

		{K}	**0.50**	**{Θ}**	**0.50**
{A,V}	**0.96**	{Ø}	0.48	{A,V}	0.48
{ Θ}	**0.04**	{K}	0.02	{Θ}	0.02

Next, we determine the user's new level of confidence in learning preference 3 by combining learning preferences 2 and 3.

m_5 {A,V} = 0.48/1-0.48 = 0.92, m_5 {K} = 0.02/1-0.48 = 0.04, m_5 {Θ} = 0.02/1-0.48 = 0.04

3. When I'm writing something down or typing on the computer, I tend to use a heavy hand. The user is a kinaesthetic learner, according to this statement {K}. Student filling in the statement with 2 means the degree of belief m_6 {K} = 0.20. Table 3 below displays a cross-tabulation of user preferences 3 and 4 about how they prefer to study.

Table 3: Combining user's learning preferences 3 and 4

		{K}	**0.20**	**{Θ}**	**0.80**
{A,V}	**0.92**	{Ø}	0.184	{A,V}	0.736
{K}	**0.04**	{K}	0.008	{K}	0.032
{ Θ}	**0.04**	{K}	0.008	{Θ}	0.032

The user's new level of confidence in learning preference 4 is derived by summing the degrees of belief in learning preferences 3 and 4.

m_7 {A,V} = 0.736/1-0.184 = 0.902, m_7 {K} = 0.008+0.032+0.008/1-0.184 = 0.059, m_7 {Θ} = 0.032/1-0.184 = 0.039

4. Diagrams, graphics, and other forms of visual learner directions need to be accompanied by thorough justifications before they can be useful to me. The user is a visual learner, according to this declaration {V}. Student filling in the statement with 6 means the degree of belief m_8 {V} = 0.60. Table 4 below displays a combination of the user's fourth and fifth preferred modes of learning.

Table 4: Combining user's learning preferences 4 and 5

		{V}	**0.60**	**{Θ}**	**0.40**
{A,V}	**0.902**	{V}	0.541	{A,V}	0.361
{K}	**0.059**	{Ø}	0.035	{K}	0.024
{ Θ}	**0.039**	{V}	0.023	{Θ}	0.016

Next, we determine the user's new level of confidence in learning preference 5 by combining learning preferences 4 and 5.

m_9 {A,V} = 0.361/1-0.035 = 0.374, m_9 {K} = 0.024/1-0.035 = 0.025
m_9 {V} = 0.541+0.023/1-0.035 = 0.584, m_9 {Θ} = 0.016/1-0.035 = 0.017

5. Next, we determine the user's new level of confidence in learning preference 5 by combining learning preferences 4 and 5. learning preference is a kinaesthetic learner {K}. The student filling in the statement with 7 means the degree of belief m_{10} {K} = 0.7. In Table 5 below, we see a combination of the user's Learning Preference 5 and Learning Preference 6.

Table 5: Combining user's learning preferences 5 and 6

		{K}	**0.70**	**{Θ}**	**0.30**
{A,V}	**0.374**	{Ø}	0.262	{A,V}	0.112
{K}	**0.025**	{K}	0.018	{K}	0.008
{V}	**0.584**	{Ø}	0.409	{V}	0.175
{Θ}	**0.017**	{K}	0.012	{Θ}	0.005

We then re-evaluate the user's level of confidence in their preferred learning style by computing the sum of their preferences for learning styles 5 and 6.

m_{11} {A,V} = 0.112/1-(0.262+0.409) = 0.34, m_{11} {K} = 0.018+0.008+0.012/1-(0.262+0.409) = 0.11
m_{11} {V} = 0.175/1-(0.262+0.409) = 0.53, m_{11} {Θ} = 0.005/1-(0.262+0.409) = 0.02

6. I find that visual representations of problems and their implications greatly aid my comprehension of those problems. The user is a visual learner, according to this declaration. {V}. The student filling in the statement with 5 means the degree of belief m_{12} {V} = 0.5. Table 6 below shows the user's combined preference for learning preferences 6 and 7.

Table 6: Combining user's learning preferences 6 and 7

		{V}	**0.50**	**{Θ}**	**0.50**
{A,V}	**0.34**	{V}	0.17	{A,V}	0.17
{K}	**0.11**	{Ø}	0.055	{K}	0.055
{V}	**0.53**	{V}	0.265	{V}	0.265
{Θ}	**0.02**	{V}	0.01	{Θ}	0.01

We then re-evaluate the user's level of confidence in learning choice 7 based on their combined preferences for learning 6 and 7.

m_{13} {A,V} = 0.17/1-0.055 = 0.181, m_{13} {K} = 0.055/1-0.055 = 0.058
m_{13} {V} = 0.17+0.265+0.265+0.01/1-0.055 = 0.75, m_{13} {Θ} = 0.01/1-0.055 = 0.011

7. If you show me a pair of sounds and ask me if they go together, I can tell you when they do. The user prefers an aural mode of instruction, according to this declaration. {A}. The student filling in the statement with 5 means degree of belief m_{14} {A} = 0.5. Table 7 below displays a user's combined preference for learning preferences 7 and 8.

Table 7: Combining user's learning preferences 7 and 8

		{A}	**0.50**	**{ Θ}**	**0.50**
{A,V}	**0.181**	{A}	0.091	{A,V}	0.091
{K}	**0.058**	{ Ø }	0.029	{K}	0.029
{V}	**0.75**	{ Ø }	0.375	{V}	0.375
{Θ}	**0.011**	{A}	0.006	{Θ}	0.006

We then re-evaluate the user's level of confidence in learning preference 8 based on their combined preference 7 and 8 scores.

m_{15} {A,V} = 0.091/1 - (0.375+0.029) = 0.15, m_{15} {K} = 0.029/1 - (0.375+0.029) = 0.05

m_{15} {V} = 0.375/1 - (0.375+0.029) = 0.63, m_{15} {A} = 0.091+0.006/1 - (0.375+0.029) = 0.16
m_{15} {Θ} = 0.006/1 - (0.375+0.029) = 0.01

8. For me, putting my thoughts down on paper or screen helps me to both retain and refine those thoughts. The user is a kinaesthetic learner, according to this statement {K}. The student filling in the statement with 8 means the degree of belief m_{16} {K} = 0.8. Table 8 below provides a summary of the user's combined choice 8 and 9 for how they learn.

Table 8: Combining user's learning preferences 8 and 9

		{K}	**0.8**	**{Θ}**	**0.2**
{A,V}	**0.15**	{Ø}	0.12	{A,V}	0.03
{K}	**0.05**	{K}	0.04	{K}	0.01
{V}	**0.63**	{Ø}	0.504	{V}	0.126
{A}	**0.16**	{Ø}	0.128	{A}	0.032
{Θ}	**0.01**	{K}	0.008	{Θ}	0.002

Next, we determine the user's new level of confidence in learning preference 9 by combining learning preferences 8 and 9.

m_{17} {A,V} = 0.03/1 - (0.12+0.128+0.504) = 0.121, m_{17} {K} = 0.04+0.008+0.01/1 - (0.12+0.128+0.504) = 0.234
m_{17} {V} = 0.126/1 - (0.12+0.128+0.504) = 0.508, m_{17} {A} = 0.032/1 - (0.12+0.128+0.504) = 0.129
m_{17} {Θ} = 0.002/1 - (0.12+0.128+0.504) = 0.008

9. When I need to get to a new city or make my way around a strange area, I pull up a map on my phone or laptop. The user is a visual learner, according to this declaration {V}. Student filling in the statement with 6 means the degree of belief m_{18} {V} = 0.6. In Table 9 below, we see the user's combined preference for learning preferences 9 and 10.

Table 9: Combining user's learning preferences 9 and 10

		{V}	**0.6**	**{Θ}**	**0.4**
{A,V}	**0.121**	{V}	0.073	{A,V}	0.048
{K}	**0.234**	{Ø}	0.140	{K}	0.094
{V}	**0.508**	{V}	0.305	{V}	0.203
{A}	**0.129**	{Ø}	0.077	{A}	0.052
{Θ}	**0.008**	{V}	0.005	{Θ}	0.003

Next, we determine the user's new level of confidence in learning preference 10 by combining learning preferences 9 and 10.

m_{19} {A,V} = 0.048/1 - (0.077+0.140) = 0.061, m_{19} {K} = 0.094/1 - (0.077+0.140) = 0.121
m_{19} {V} = 0.073+0.305+0.203+0.005/1 - (0.077+0.140) = 0.748, m_{19} {A} = 0.052/1 - (0.077+0.140) = 0.066
m_{19} {Θ} = 0.003/1 - (0.077+0.140) = 0.004

10. In my opinion, it is simpler to learn through auditory means, such as listening to CDs, MP3s, or file casts. The user prefers an aural mode of instruction, according to this declaration {A}. The student filling in the statement with 7 means degree of belief m_{20} {A} = 0.7. Table 10 below provides a summary of the user's combined learning preferences for preferences 10 and 10.

Table 10: Combining user's learning Preferences 10 and 11

		{A}	**0.7**	**{Θ}**	**0.3**
{A,V}	**0.061**	{A}	0.043	{A,V}	0.018
{K}	**0.121**	{Ø}	0.085	{K}	0.036
{V}	**0.748**	{Ø}	0.524	{V}	0.224
{A}	**0.066**	{A}	0.046	{A}	0.02
{Θ}	**0.004**	{A}	0.003	{Θ}	0.001

The user's new level of confidence in learning preference 11 is derived by summing the user's previous levels of confidence in learning preferences 10 and 11.

m_{21} {A,V} = 0.018/1 - (0.524+0.085) = 0.046, m_{21} {K} = 0.036/1 - (0.524+0.085) = 0.092
m_{21} {V} = 0.224/1 - (0.524+0.085) = 0.573, m_{21} {A} = 0.043+0.046+0.02+0.003/1 - (0.524+0.085) = 0.286
m_{21} {Θ} = 0.001/1 - (0.524+0.085) = 0.003

11. I like to fiddle with the pens, keys, and other items around me while I study. The user is a kinaesthetic learner, according to this statement {K}. The student filling in the statement with 8 means the degree of belief m_{22} {K} = 0.8. Table 11 below provides a summary of the user's combined 11 and 12 learning preferences.

Table 11: Combining user's learning Preferences 11 and 12

		{K}	**0.8**	**{Θ}**	**0.2**
{A,V}	**0.046**	{Ø}	0.037	{A,V}	0.009
{K}	**0.092**	{K}	0.074	{K}	0.018
{V}	**0.573**	{Ø}	0.458	{V}	0.115
{A}	**0.286**	{Ø}	0.229	{A}	0.057
{Θ}	**0.003**	{K}	0.002	{Θ}	0.001

To further refine our confidence in the user's choice 12, we compute the sum of the user's preferences 11 and 12.

m_{23} {A,V} = 0.009/1 - (0.037+0.229+0.458) = 0.032, m_{23} {K} = 0.074+0.018+0.002/1 - (0.037+0.229+0.458) = 0.341
m_{23} {V} = 0.115/1 - (0.037+0.229+0.458) = 0.417 , m_{23} {A} = 0.057/1 - (0.037+0.229+0.458) = 0.206
m_{23} {Θ} = 0.001/1 - (0.037+0.229+0.458) = 0.004

12. I find that saying the words and letters out helps me remember them better. The user prefers an aural mode of instruction, according to this declaration {A}. The student filling in the statement with 7 means the degree of belief m_{24} {A} = 0.7. Table 12 below displays the user's total learning preference 12 + user's total learning preference 13.

Table 12: Combining user's learning Preferences 12 and 13

		{A}	**0.7**	**{Θ}**	**0.3**
{A,V}	**0.032**	{A}	0.022	{A,V}	0.01
{K}	**0.341**	{Ø}	0.239	{K}	0.102
{V}	**0.417**	{Ø}	0.292	{V}	0.125
{A}	**0.206**	{A}	0.144	{A}	0.062
{Θ}	**0.004**	{A}	0.003	{Θ}	0.001

We then re-evaluate the user's level of confidence in learning preference 14 by computing the sum of learning preferences 13 and 14.

m_{25} {A,V} = 0.01/1 - (0.292+0.239) = 0.021, m_{25} {K} = 0.102/1 - (0.292+0.239) = 0.217
m_{25} {V} = 0.125/1 - (0.292+0.239) = 0.267, m_{25} {A} = 0.022+0.144+0.062+0.003/1 - (0.292+0.239) = 0.493
m_{25} {Θ} = 0.001/1 - (0.292+0.239) = 0.002

13. Than keep up with current events, I prefer reading to listening to the radio or watching television. The user is a visual learner, according to this declaration {V}. The student filled the statement with 5, which means the degree of belief m_{26} {V} = 0.5. Table 13 below provides a summary of the user's combined 13 and 14 learning preferences.

Table 13: Combining user's learning Preferences 13 and 14

		{V}	**0.5**	**{Θ}**	**0.5**
{A,V}	**0.021**	{V}	0.011	{A,V}	0.011
{K}	**0.217**	{Ø}	0.108	{K}	0.108
{V}	**0.267**	{V}	0.134	{V}	0.134
{A}	**0.493**	{Ø}	0.246	{A}	0.246
{Θ}	**0.002**	{V}	0.001	{Θ}	0.001

We then re-evaluate the user's level of confidence in learning preference 14 by computing the sum of learning preferences 13 and 14.

m_{27} {A,V} = 0.011/1 - (0.246+0.108) = 0.017, m_{27} {K} = 0.108/1 - (0.246+0.108) = 0.167
m_{27} {V} = 0.011+0.134+0.134+0.001/1 - (0.246+0.108) = 0.433, m_{27} {A} = 0.246/1 - (0.246+0.108) = 0.381
m_{27} {Θ} = 0.001/1 - (0.246+0.108) = 0.002

14. I absorb information best when I am actively engaged in making, fixing, or bettering something. The user is a kinaesthetic learner, according to this statement {K}. The student filling in the statement with 7 means the degree of belief m_{28} {K} = 0.7. Table 14 below displays a tabulation of the user's combined learning preferences 14 and 15.

Table 14: Combining user's learning preferences 14 and 15

		{K}	**0.7**	**{Θ}**	**0.3**
{A,V}	**0.017**	{Ø}	0.012	{A,V}	0.005
{K}	**0.167**	{K}	0.117	{K}	0.05
{V}	**0.433**	{Ø}	0.303	{V}	0.130
{A}	**0.381**	{Ø}	0.267	{A}	0.114
{Θ}	**0.002**	{K}	0.001	{Θ}	0.001

Next, we determine the user's new level of confidence in learning preference 15 by combining learning preferences 14 and 15.

m_{29} {A,V} = 0.005/1 - (0.012+0.267+0.303) = 0.012, m_{29} {K} = 0.117+0.05+0.001/1 - (0.012+0.267+0.303) = 0.402
m_{29} {V} = 0.13/1 - (0.012+0.267+0.303) = 0.311, m_{29} {A} = 0.114/1 - (0.012+0.267+0.303) = 0.273
m_{29} {Θ} = 0.001/1 - (0.012+0.267+0.303) = 0.002

15. Creating an image in my mind helps me retain information. The user is a visual learner, according to this declaration{V}. Student filling in the statement with 5 means the degree of belief m_{30} {V} = 0.5. Table 15 below provides a summary of the user's combined 15th and 16th learning preferences.

Table 15: Combining user's learning preferences 15 and 16

		{V}	**0.5**	**{Θ}**	**0.5**
{A,V}	**0.012**	{V}	0.006	{A,V}	0.006
{K}	**0.402**	{Ø}	0.201	{K}	0.201
{V}	**0.311**	{V}	0.156	{V}	0.156
{A}	**0.273**	{Ø}	0.136	{A}	0.136
{Θ}	**0.002**	{V}	0.001	{Θ}	0.001

Next, we determine the user's new level of confidence in learning preference 16 by combining learning preferences 15 and 16.

m_{31} {A,V} = 0.006/1 - (0.136+0.201) = 0.009, m_{31} {K} = 0.201/1 - (0.136+0.201) = 0.303
m_{31} {V} = 0.006+0.156+0.156+0.001/1 - (0.136+0.201) = 0.481, m_{31} {A} = 0.136/1 - (0.136+0.201) = 0.205
m_{31} {Θ} = 0.001/1 - (0.136+0.201) = 0.002

16. When I was a kid, I benefited most from practising my spelling and grammar by writing out sentences. The user is a kinaesthetic learner, according to this statement {K}. The student filling in the statement with 4 means the degree of belief m_{32} {K} = 0.4. Table 16 below displays a combination of the user's learning preferences 16 and 17 for easy reference.

Table 16: Combining user's learning Preferences 16 and 17

		{K}	**0.4**	**{Θ}**	**0.6**
{A,V}	**0.009**	{Ø}	0.004	{A,V}	0.005
{K}	**0.303**	{K}	0.121	{K}	0.182
{V}	**0.481**	{Ø}	0.192	{V}	0.289
{A}	**0.205**	{Ø}	0.082	{A}	0.123
{Θ}	**0.002**	{K}	0.001	{Θ}	0.001

The user's new level of confidence in learning preference 17 is then determined by computing the product of the user's learning preferences 16 and 17.

m_{33} {A,V} = 0.005/1 - (0.004+0.082+0.192) = 0.007, m_{33} {K} = 0.121+0.182+0.001/1 - (0.004+0.082+0.192) = 0.422
m_{33} {V} = 0.289/1 - (0.004+0.082+0.192) = 0.4, m_{33} {A} = 0.123/1 - (0.004+0.082+0.192) = 0.170
m_{33} {Θ} = 0.001/1 - (0.004+0.082+0.192) = 0.001

17. I find that listening to an engaging speaker is more informative than reading about the same topics in print or online. According to this declaration, the user prefers to learn through both aural and visual means {A, V}. Student filling in the statement with 8 means the degree of belief m_{34} {A, V} = 0.8. Table 17 below displays a combination of the user's preferred method of learning (17) and the user's preferred method of learning (18).

Table 17: Combining user's learning Preferences 17 and 18

		{A, V}	**0.8**	**{Θ}**	**0.2**
{A,V}	**0.007**	{A,V}	0.006	{A,V}	0.001
{K}	**0.422**	{Ø}	0.338	{K}	0.084
{V}	**0.4**	{V}	0.32	{V}	0.08
{A}	**0.170**	{A}	0.136	{A}	0.034
{Θ}	**0.001**	{A,V}	0.001	{Θ}	0.0002

The user's new level of confidence in learning preference 18 is derived by summing the user's previous levels of confidence in learning preferences 17 and 18.

m_{35} {A,V} = 0.006 + 0.001 + 0.001/1 - 0.338 = 0.012, m_{35} {K} = 0.084/1 - 0.338 = 0.127
m_{35} {V} = 0.32 + 0.08/1 - 0.338 = 0.604, m_{35} {A} = 0.136 + 0.034/1 - 0.338= 0.257
m_{35} {Θ} = 0.0002/1 - 0.338 = 0,0003

18. Jigsaw puzzles and other brain teasers are fun and interesting activities for me. The user is a kinaesthetic learner, according to this statement {K}. The student filled the statement with 6, which means the degree of belief m_{36} {K} = 0.6. Table 18 below displays a tabulation of the user's combined 18 and 19 learning preferences.

Table 18: Combining user's learning Preferences 18 and 19

		{K}	**0.6**	**{Θ}**	**0.4**
{A,V}	**0.012**	{Ø}	0.007	{A,V}	0.005
{K}	**0.127**	{K}	0.076	{K}	0.051
{V}	**0.604**	{Ø}	0.362	{V}	0.242
{A}	**0.257**	{Ø}	0.154	{A}	0.103
{Θ}	**0.0003**	{K}	0.0002	{Θ}	0.0001

We then re-evaluate the user's level of confidence in learning preference 19 based on the sum of learning preferences 18 and 19.

m_{37} {A,V} = 0.005/1 – (0.007 + 0.154 + 0.362) = 0.01
m_{37} {K} = 0.076 + 0.051 + 0.0002/1 - (0.007 + 0.154 + 0.362) = 0.267
m_{37} {V} = 0.242/1 - (0.007 + 0.154 + 0.362) = 0.507, m_{37} {A} = 0.103/1 - (0.007 + 0.154 + 0.362) = 0.216
m_{37} {Θ} = 0.0001/1 - (0.007 + 0.154 + 0.362) = 0.0002

19. I find it helpful to have physical objects in my hands during study sessions. The user is a kinaesthetic learner, according to this statement {K}. Student filling in the statement with 7 means the degree of belief m_{38} {K} = 0.7. You can see the results of the overlap between the user's learning preferences 19 and 20 in Table 19.

Table 19: Combining user's learning Preferences 19 and 20

	{K}	**0.7**	**{Θ}**	**0.3**

{A,V}	**0.01**	{Ø}	0.007	{A,V}	0.003
{K}	**0.267**	{K}	0.187	{K}	0.08
{V}	**0.507**	{Ø}	0.355	{V}	0.152
{A}	**0.216**	{Ø}	0.151	{A}	0.065
{Θ}	**0.0002**	{K}	0.0001	{Θ}	0.00006

The user's new level of confidence in learning preference 20 is then determined by computing the sum of the user's learning preferences 19 and 20.

m_{39} {A,V} = 0.003/1 – (0.007 + 0.151 + 0.355) = 0.006
m_{39} {K} = 0.187+0.08+0.0001/1 - (0.007 + 0.151 + 0.355) = 0.548, m_{39} {V} = 0.152/1 - (0.007 + 0.151 + 0.355) = 0.312, m_{39} {A} = 0.065/1 - (0.007 + 0.151 + 0.355) = 0.133, m_{39} {Θ} = 0.00006/1 - (0.007 + 0.151 + 0.355) = 0.00001

20. Instead of reading a newspaper or magazine, I'd rather listen to the news on my phone, the radio, or online. According to this declaration, the user prefers to learn through both aural and visual means {A, V}. Student filed the statement with 9, which means the degree of belief m_{40} {A, V} = 0.9. Table 20 below tabulates the user's combined learning preference 20 and learning preference 21.

Table 20: Combining user's learning Preferences 20 and 21

		{A, V}	**0.9**	**{Θ}**	**0.1**
{A,V}	**0.006**	{A,V}	0.005	{A,V}	0.0006
{K}	**0.548**	{Ø}	0.493	{K}	0.055
{V}	**0.312**	{V}	0.281	{V}	0.031
{A}	**0.133**	{A}	0.120	{A}	0.013
{Θ}	**0.00001**	{A,V}	0.000009	{Θ}	0.000001

The user's new level of confidence in learning preference 21 is then determined by computing the sum of the user's learning preferences 20 and 21.

m_{41} {A,V} = 0.005+0.0006+0.000009/1 – 0.493 = 0.011, m_{41} {K} = 0.055/1 - 0.493 = 0.109
m_{41} {V} = 0.281+0.031/1 - 0.493 = 0.615, m_{41} {A} = 0.120+0.013/1 - 0.493 = 0.262
m_{41} {Θ} = 0.000001/1 - 0.493 = 0.000002

21. When I want to learn more about a topic that piques my interest, I turn for resources like books, magazines, and the Internet. The user is a visual learner, according to this declaration {V}. The student filled the statement with 6, which means the degree of belief m_{42} {V} = 0.6. In Table 21 below, we see the user's combined learning preferences (Preference 21 + Preference 22).

Table 21: Combining user's learning Preferences 21 and 22

		{V}	**0.6**	**{Θ}**	**0.4**
{A,V}	**0.011**	{V}	0.007	{A,V}	0.004
{K}	**0.109**	{Ø}	0.065	{K}	0.044
{V}	**0.615**	{V}	0.369	{V}	0.246
{A}	**0.262**	{Ø}	0.157	{A}	0.105
{Θ}	**0.000002**	{V}	0.000001	{Θ}	0.000001

The user's new level of confidence in learning preference 22 is then determined by computing the sum of the user's learning preferences 21 and 22.

m_{43} {A,V} = 0.004/1 – (0.157+0.065) = 0.005, m_{43} {K} = 0.044/1 - (0.157+0.065) = 0.06
m_{43} {V} = 0.007+0.369+0.246+0.000001/1 - (0.157+0.065) = 0.80, m_{43} {A} = 0.105/1 - (0.157+0.065) = 0.135
m_{43} {Θ} = 0.000001/1 - (0.157+0.065) = 0.000001

22. When it comes to making physical touch with other individuals, I am completely at ease (handshake, embrace). The user is a kinaesthetic learner, according to this statement. {K}. The student filled the statement with 5, which means the degree of belief m_{44} {K} = 0.5. Table 22 below provides a summary of the user's combined 22 and 23 learning preferences.

Table 22: Combining user's learning preferences 22 and 23

		{K}	**0.5**	**{Θ}**	**0.5**
{A,V}	**0.005**	{Ø}	0.002	{A,V}	0.003
{K}	**0.06**	{K}	0.03	{K}	0.03
{V}	**0.80**	{Ø}	0.4	{V}	0.4
{A}	**0.135**	{Ø}	0.067	{A}	0.068
{Θ}	**0.000001**	{K}	0.0000005	{Θ}	0.0000005

We then re-evaluate the user's level of confidence in learning preference 23 by computing the sum of the user's learning preferences 22 and 23.

m_{45} {A,V} = 0.003/1 – (0.002+0.067+0.4) = 0.006, m_{45} {K} = 0.03+0.03+0.0000005/1 - (0.002+0.067+0.4) = 0.113
m_{45} {V} = 0.4/1 - (0.002+0.067+0.4) = 0.753, m_{45} {A} = 0.068/1 - (0.002+0.067+0.4) = 0.128
m_{45} {Θ} = 0.0000005/1 - (0.002+0.067+0.4) = 0.0000009

23. It's been my experience that I do better with verbal instructions than written ones. According to this declaration, the user prefers to learn through both aural and visual means. {A, V}. The student filled the statement with 8, which means the degree of belief m_{46} {A, V} = 0.8. Below, Table 23 provides a summary of how users who have selected both Preference 23 and Preference 24 have rated their overall learning experience.

Table 23: Combining learning preference answer

		{A, V}	**0.8**	**{Θ}**	**0.2**
{A,V}	**0.006**	{Ø}	0.005	{A,V}	0.001
{K}	**0.113**	{K}	0.09	{K}	0.023
{V}	**0.753**	{Ø}	0.602	{V}	0.151
{A}	**0.128**	{Ø}	0.102	{A}	0.026
{Θ}	**0.0000009**	{K}	0.0000007	{Θ}	0.0000002

We then re-evaluate the user's level of confidence in learning preference 24 by computing the sum of the user's preferences 23 and 24.

m_{47} {A,V} = 0.001/1 – (0.005+0.102+0.602) = 0.003, m_{47} {K} = 0.09+0.023+0.0000007/1 - (0.005+0.102+0.602) = 0.388
m_{47} {V} = 0.151/1 - (0.005+0.102+0.602) = 0.519, m_{47} {A} = 0.026/1 - (0.005+0.102+0.602) = 0.090
m_{47} {Θ} = 0.0000002/1 - (0.005+0.102+0.602) = 0.0000007

The final result is 0.519 > 0.388 > 0.090 > 0.003. Visual learner > Kinaesthetic >Auditory learner > Auditory learner, Visual learner

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