

# Effectiveness of a Technology-Based Strategy on Adolescents' Knowledge on Diabetes Mellitus

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**Abstract--Background:** The international diabetes federation (IDF, 2015) reveals that 415 million people in the world suffer from diabetes mellitus. IDF further reports that about 542,000 adolescents worldwide with T1DM. In the Philippines, 3.5 million cases of DM have been reported in 2015. The incidence of diabetes mellitus on adolescent age is increasing in this generation that necessitates the dissemination of information about promoting health and prevention of diseases. This research determined the effectiveness of a technology-based strategy (TBS) on the knowledge of adolescents about diabetes mellitus (DM). The method of this research was a quasiexperimental design, the experimental group (153) was exposed to a TBS or the blog site and a control group (200) which was provided with the Department of Health's brochure (DOH). The blog site contained information about DM. The printed brochure from the DOH is entitled "Living with Diabetes" contains information about DM too. A modified questionnaire with a CVI=0.71, was utilized to gather data from grade 11 students from 10 sections of the University of the Cordilleras, Baguio City. The respondents are 15-18 years old who voluntarily participated in the study selected through random sampling. Frequency, percentage, and t-test were used in the analysis of data. The result showed that the experimental group shows an increase in knowledge after using the intervention which is the blog site from a general mean score of 2.50 interpreted as Limited Knowledge (LK) in the pretest to 3.30 interpreted as Much Knowledge (MK) in the post test. There is no significant difference in the effectiveness of TBS in the knowledge of adolescents on DM according to length of access with a t-test value 0.46, while there is a significant difference in the effectiveness of TBS in the knowledge of adolescents according to groups where t-test value is 2.57 at 0.05

level of significance. **Conclusion,** the use of technologybased strategy or blog site is effective in increasing the knowledge of the adolescent regarding DM in terms of nature, etiology, signs and symptoms, management, and prevention and it is more effective than the use of brochure.

**Keywords:** *effectiveness, technology-based strategy, blog site, diabetes mellitus*

## I. INTRODUCTION

The International Diabetes Federation [1] reveals that 415 million people in the world suffer from Diabetes Mellitus. Diabetes Mellitus (DM) is a chronic illness where the body does not produce insulin or does not use insulin resulting to the increased levels of glucose in the blood. There are two types of Diabetes Mellitus: Type 1 diabetes mellitus (T1DM) and Type 2 diabetes mellitus (T2DM). T1DM is a chronic condition caused by impairment of pancreatic beta cells that are responsible for producing insulin, which has the function of lowering blood sugar levels [2]. While T2DM is a long-term metabolic disorder that is characterized by high blood sugar, insulin resistance and relative lack of insulin. T2DM is due primarily to lifestyle factors and genetics.

IDF reports that there are about 542,000 adolescents worldwide with T1DM. In the Philippines, 3.5 million cases of DM have been reported as of 2015. However this does not include the 1.84 million cases that were undiagnosed. By 2025, health professionals first predicted 320 million people worldwide will have DM. Yet due to the recent statistics of

2015, that number have already exceeded 400 million. DM claims the lives of 57,000 people annually, making it number four on the deadliest diseases in the Philippines. In like manner, T2DM is rare in childhood and adolescence but recent reports indicate an increasing prevalence of T2DM in children and adolescence around the world in all ethnicities (Reinehr T., 2013).

Similarly, Asians have a strong ethnic and genetic predisposition for diabetes and have lower thresholds for the environmental risk factors. As a result, they develop diabetes at a young age [3]. Other than that, the main risk factors for T2DM in children and adolescents are obesity combined with genetic predisposition or family history in addition with children born small for gestational age, newborn macrosomia of diabetic mother, and premature adrenarche in girls [4].

The increasing number of adolescents with Diabetes Mellitus is a concern of health care professionals and families as well. Such that, Dennis (2003) and Sansom-Daly et al., (2012) states that in order to effectively care for patients with DM, there should be peer support groups which generally aims to provide emotional and informational support to people with a chronic illness in order to promote illness self-management, health, and wellbeing. Baumann and Dang (2012) also share that those people who are diagnosed with similar chronic conditions such as DM can share knowledge and experiences that are unavailable from health care professionals and they should be members in peer groups. Furthermore, behavioral interventions are designed to improve levels of self-care by applying psychological principles to assist people with diabetes in making desired changes to their behavior patterns and lifestyle (Hampson et al. 2000).

While the previous studies above focused on the importance of support groups' assistance to health care professionals in dealing with the care of DM patients, Shah, V. & Garg, S. (2015) share that in managing DM in this digital age, a number of mobile applications, internet portal, and websites are available to help patients to improve their diabetes care. With the increasing use of smart phones and internet, there is an opportunity to use digital tools for training people with DM to self-manage their disease, thus the researchers considered a technological strategy to benefit DM patients.

As today's generation is well known for its technological advances, health professionals and internet groups have been informing the public about DM and the Department of Health in the Philippines using printed materials, TV, and radios. Some studies utilized technology to benefit DM patients such as the study of Franklin, Waller, Pagliari, & Greene [5], where they discovered that a text messaging support system called "Sweet Talk" resulted in

the adolescents' enhanced self-efficacy, increased awareness of support from a diabetes group, and also increased their adherence but there was no impact on the adolescents' knowledge on DM and on glycemic control.

Recent studies reported that today's generation are more highly accessible to information, as such it was reported that adolescents are expected to be knowledgeable regarding the development of T2DM and the maintenance of at least 60 minutes of moderate intensity physical activity on most days of the week [6]. Outley, et. al (2015) suggest that there are positive aspects of online technology, especially in providing opportunities for youth to develop and maintain a sense of connectedness in an online environment. Granite & Chernobilsky [7] share that students of the 21st century may retain more information if it comes to them through a digital medium, thus in a more digital world, online teaching tools are better for a student's memory.

Considering that the 21<sup>st</sup> century youth highly utilize technology for accessing information and for online interaction, the researchers then determined the effectiveness of a technology-based strategy on the knowledge of adolescents about DM. In the present study, the adolescents were exposed to a technology based strategy, which is a blog site entitled "Leave out the Sugar". The blog used was an example of a network that provided information about DM, and the researchers were the ones to provide the knowledge about DM in the blog.

## II. METHOD

This research is a quasi-experimental design. The population in this study were adolescents who are 15-18 years old, male or female, grade 11 students from the University of the Cordilleras, Baguio City, who willingly participated in the study with their assent forms signed and consent given by their parents or guardians as much as 3690 students. The samples in this studies used openepi.com, the sample size was 349, with a confidence level of 95%, which is equivalent to 8 sections with 45 students each, where 200 respondents were assigned to the control group and 153 respondents to the experimental group. The data were collected by using a questionnaire based on a 24-item Diabetes Knowledge Questionnaire (DKQ) which gathered data on knowledge on diabetes mellitus of Spanish people in America developed by Brown, Garcia, Hanis, Kouzekanani, & Villagomez [8] translated in English. This questionnaire was used to assess overall diabetes knowledge of the adolescents. Data were analyzed by univariate analysis using frequency and percentage. The significant difference in the effectiveness of TBS on the knowledge of adolescents on DM according to the length of access was determined by using the one sample T-test. To determine if there is a

significant difference in the extent of knowledge of the adolescents regarding diabetes mellitus according to groups, two-sample t-test was used, using 0.05 for the level of significance.

The Technology Based Strategy was the blog site with the ink: <https://leaveoutthesugar.wordpress.com>. It is user friendly to all adolescent users in which the contents feature diabetes mellitus, such as its nature, etiology, signs and symptoms, management and prevention. This blog is a regularly updated website or webpage, typically run by an individual or small group that is written in an informal or conversational style. The research group is served as the administrators of the blog and has the responsibility of answering queries from the users who accessed the blog daily. Daily Blog information basis such as: Day 1: nature of DM; Day 2: Etiology; Day 3: signs and symptoms; Day 4: Management; Day 5: Prevention. The blog site utilized English as the medium of communication. There were two parts of the blog site: Part I is the home page containing links to all the contents of the blog. Part II consists the features of DM, as to nature, signs and symptoms, etiology, management, and prevention. Medical terms have been defined. If the respondents had questions, there will be link containing frequently asked questions (FAQ).

Queries unanswered in the link may be directed to the researchers by sending a message in the comments section. The content validity of the blog site was confirmed also by Dr. Maria Alice Torres, Mr. Jefferson Galanza and Mr. Stephen Zarate. Their comments and suggestions have been addressed accordingly. The brochure from the Department of Health entitled „Living with Diabetes“ was given to the control group. The brochure was in English and it contained information about living with DM. Initially, the researcher gave a letter to the director of the University of the Cordilleras, Baguio City, Benguet for a permission to conduct a study entitled “Effectiveness of a Technologybased Strategy (TBS) on Adolescents“ Knowledge on Diabetes Mellitus”. Once approved, the study proceeded adhering to the study protocol. Participants were ensured in knowing everything about the research. The blog guaranteed that their information was secured. The researchers ensured that there would be no invasive procedures like injections or any procedures that could harm the participants. The researchers also provided information on the process of the study: the risks, the benefits, and also

the nature of the study by giving the respondents the assent and a consent form for the parents of the participants. They also had the right to quit at any time during the study, even if it’s still in the process, we would respect their right to back out. Their decision to join the study was voluntary. All the terms, condition, and knowledge were provided prior to giving of assent form to the participants and a consent form was given for their parents. These conditions were based in the principle of beneficence and the rights and privacy of our participants.

### III. RESULTS AND DISCUSSION

#### *A. Frequency and Percentage Distribution of Responses Regarding Effectiveness of Technology Based Strategy*

As seen in the Table 1. a the frequency and percentage distribution of responses regarding the effectiveness of TBS on the knowledge of adolescents about DM in each item shows changes from the pretest to the post-test results. Specifically, along nature of DM as a disease, only 13% got the correct “No” answer and 87% got wrong answers in the pretest of item number 1, “kidneys produce insulin.” It must be noted that kidneys do not produce insulin, but these are two bean-shaped organs that help the body pass waste as urine and help filter blood before sending it back to the heart. Item 2 shows an increase from the 57% getting the correct answer in the pretest to 90.19% in the post test. In the TBS, it was emphasized that there are two types of DM which are Type 1 DM and Type 2 DM. Type 1 DM is also known as juvenile diabetes or insulin dependent diabetes that is a chronic condition in which the pancreas little or no insulin. Furthermore, it has no cure and person with DM1 is dependent on insulin. While type 2 DM is also a chronic condition that affects the way your body metabolizes sugar or glucose, it also has no cure but signs and symptoms are manageable. Item 3 which states that “diabetes can be cured” shows 26% correct answers in the pretest period which increased by 55.56% in the posttest. As pointed out in the TBS/blog site, DM cannot be cured, however, the complication can be controlled or prevented. Item 4 which states that “If diabetes is uncontrolled, the amount of sugar in the blood usually increases” showed 82% correct answers during the pretest while posttest shows 96.73% correct answers. This information is also contained in the blog site where in type 1 DM, increase sugar level is caused by the

**TABLE 1.A FREQUENCY AND PERCENTAGE DISTRIBUTION OF PRE AND POST TEST RESPONSES REGARDING THE EFFECTIVENESS OF TECHNOLOGY BASED STRATEGY ON KNOWLEDGE OF ADOLESCENTS ON DIABETES MELLITUS**

<b>Diabetes Mellitus</b>	<b>Yes</b>	<b>No</b>	<b>I don't know</b>
Nature	56 (36%)	*21 (13%)	79 (51%)
1. Kidneys produce insulin	<b>63 (41.18%)</b>	<b>79(51.63%)</b>	<b>11 (7.19%)</b>
2. The two main types of diabetes are Type 1 and Type	*89 (57%)	11 (7%)	56 (36%)
	<b>138(90.19%)</b>	<b>8 (5.23%)</b>	<b>7 (4.58%)</b>
3. Diabetes can be cured	97(62%)	*41(26%)	18(12%)
	<b>60 (39.21%)</b>	<b>85(55.56%)</b>	<b>8 (5.23%)</b>
4. If diabetes is uncontrolled, the amount of sugar in the blood usually increases	*128 (82%)	12 (8%)	16 (10%)
	<b>148(96.73%)</b>	<b>3 (1.96%)</b>	<b>2 (1.31%)</b>
5. If I am diabetic, my children have a higher chance of being diabetic.	*107 (69%)	17(11%)	32(21%)
	<b>124(80.72%)</b>	<b>23(15.36%)</b>	<b>6(3.92%)</b>
6. The normal blood sugar level is from 80 to 100mg/dl.	*33(21%)	17(11%)	106(68%)
	<b>108(70.59%)</b>	<b>20(13.07%)</b>	<b>25(16.34%)</b>
Signs and Symptoms			
7. Dry or cracked skin is observed in people with diabetes.	*55(35%)	21(13%)	80(51%)
	<b>115(75.16%)</b>	<b>24(15.68%)</b>	<b>14(9.15%)</b>
8. There is slow healing of wounds.	*130(83%)	5(3%)	21(13%)
	<b>142(92.81%)</b>	<b>6(3.92%)</b>	<b>5(3.26%)</b>
9. Pale blue color of skin of extremities (eventually damage)	*44(28%)	19(12%)	93(60%)
	<b>79(51.63%)</b>	<b>50(32.68%)</b>	<b>24(15.68%)</b>
10. Cold feet or hands.	*47(30%)	19(12%)	90(58%)
	<b>94(61.43%)</b>	<b>39(25.49%)</b>	<b>20(13.07%)</b>
11. Shaking and sweating which are signs of high blood sugar or hyperglycemia	77(49%)	*10(6%)	69(44%)
	<b>105(68.62%)</b>	<b>37(24.18%)</b>	<b>11 (7.19%)</b>
12. Frequent urination and thirst are signs of low blood sugar or hypoglycemia.	*67(43%)	10(6%)	79(51%)
	<b>112(73.20%)</b>	<b>28 (18.3%)</b>	<b>13 (8.49%)</b>
Etiology:			
13. Eating too much sugar and other sweet foods is a cause of diabetes	*135(87%)	9(6%)	12(8%) 3
	<b>139(90.85%)</b>	<b>11 (7.18%)</b>	<b>(1.96%)</b>
14. Lack of effective insulin in the body (the usual cause of diabetes).	*76(49%)	10(6%)	70(45%)
	<b>124(81.04%)</b>	<b>15 (9.80%)</b>	<b>14 (9.15%)</b>
15. Diabetes is caused by failure in the kidneys to keep sugar out of the urine.	76(49%)	*14(9%)	66(42%)
	<b>104(67.97%)</b>	<b>37 24.18%)</b>	<b>12 (7.84%)</b>
16. An insulin reaction is caused by too much food.	47(30%)	*32(21%)	77(49%)
	<b>78 (50.98%)</b>	<b>54 (35.2%)</b>	<b>21 (13.7%)</b>
Management			
17. The best way to check diabetes is by having blood sugar checked.	*137(88%)	2(1%)	17(11%)
	<b>146 95.42%)</b>	<b>6 (3.92%)</b>	<b>1 (0.65%)</b>
18. Medication is more important than diet and exercise to control my diabetes.	41(26%)	*91(58%)	24(15%)
	<b>43 (28.10%)</b>	<b>104 67.9%)</b>	<b>6 (3.92%)</b>
19. Person with diabetes should take extra care when cutting their toenails.	*79(51%)	15(10%)	62(40%)
	<b>111(72.55%)</b>	<b>24(15.69%)</b>	<b>18 (11.76%)</b>
20. A person with diabetes should clean a wound with iodine and alcohol.	57(37%)	*15(10%)	84(54%)
	<b>90 (58.82%)</b>	<b>37(24.18%)</b>	<b>26 (16.99%)</b>
21. Tight elastic hose or socks are not bad for persons with diabetes.	24(15%)	*41(26%)	91(58%)
	<b>50 (32.68%)</b>	<b>79(51.63%)</b>	<b>24 (15.69%)</b>
22. A diabetic diet consists mostly of special food (less carbohydrate).	*80(51%)	14(9%)	62(40%)
	<b>120(78.43%)</b>	<b>19(12.42%)</b>	<b>14 (9.15%)</b>
Prevention			
23. Regular exercise with balanced diet prevents diabetes.	*133(85%)	8(5%)	15(10%)
	<b>148(96.73%)</b>	<b>4 (2.61%)</b>	<b>1 (0.65%)</b>
24. Avoiding too much sugar and sweets can lessen the risk of having DM.	*128(82%)	7(4%)	21(13%)
	<b>148(96.73%)</b>	<b>3 (1.96%)</b>	<b>2 (1.31%)</b>

destruction of cells in the immune system that release insulin resulting to a decrease insulin production from the body. This condition may lead to the inability of the cells to absorb sugar, which is needed to produce energy. In type 2 DM, the pancreas makes more insulin to try to get glucose into the cell and this may lead to the buildup of sugar in the blood.

For item 5, which states “That if I am diabetic, my children will have a higher chance of being diabetic” shows 69% correct responses during pretest which increased to 80.72%. The increase in the correct answers can also be attributed to genetics or heredity that is explained in the blog, wherein DM can be hereditary and can be transferred from parents to children.

Notably item 11 (shaking and sweating are signs of high blood sugar or hyperglycemia) shows only 6% of correct pretest result and 24.18% of correct post test result. Similarly, item 15 (Diabetes is caused by failure in the kidneys to keep sugar out of the urine), shows only 9% correct answers during the pretest, increased to 24.18% during the post test. Although, there is an increase, it is still below 50%. Likewise, same results are seen in item 16 (an insulin reaction is caused by too much food. The information that the pancreas makes a hormone called insulin that triggers body cells to convert glucose from the food eaten into energy, is contained in the blog, but further emphasis maybe needed in the discussion of signs and symptoms and etiology of DM.

In the management of diabetes mellitus, data shows a high percentage of correct answers in the pretest and post test results, except for item 21 (tight elastic hose or socks are not bad for persons with diabetes) where only 26% shows correct answers in the pretest and 51.63% in the post test. Management of DM includes monitoring blood sugar levels several times a day to determine changes in the blood sugar through capillary blood glucose test. This result implied that management should be well known by the public, thus it must be more emphasized in the blog site.

Lastly, item 23-24 talks about the prevention of DM. Items 23 has 133 responses who choose “Yes” which is 85% of the total respondents during the pretest while posttest result shows an increase of 148 responses choosing “Yes” which is 96.73% of the total respondents during posttest. And item 24 shows 128 responses who choose “Yes” which is 82% of the total respondents during pretest while posttest result shows an increase of 148 responses who answers “Yes” which is equal to 96.73% of the total respondents during posttest.

The result of the frequency and distribution of responses during the pretest and posttest period varies in each item. All items were mostly answered correctly in most all of the items during the pretest and show an increase during the posttest after giving the intervention; however, some items answered incorrectly were mostly answered during the pretest period and it was increase during the posttest period even after giving the intervention to the respondents. The intervention given to the respondents was the utilization of a blog site where information about DM was given on a daily basis for about 3 and 4 weeks and they were instructed to access the blog site for 3 and 4 weeks to update themselves to new information being input in the blog. The content of the blog site is about the Nature, Etiology, Signs and symptoms, Management and Prevention

of Diabetes Mellitus. According to Shapiro and Margolin (2014), adolescents and young adults initially dominated the social networking sites such as Facebook which adolescents who are 11-18 years old spend 11 hours per day exposed to electronic media. The length of time these adolescents utilized per day gave them much information from different sites they had browsed and read. Utilizing the blog site as a means of intervening with the adolescents in providing information about DM is appropriate for these youth-driven phenomena. Furthermore, Guang, Badri, Nuaimi, and Al Rashedi (2017) noted that social networking has become an integral part of a children’s social life; it is now seen as a learning platform that could be utilized to enhance student engagement and performance. In addition, social networking and media tools such as tablets, smart phones, etc. offer school children the opportunity to communicate, access information, research and chat. They also stress that social media play a key role in people’s lives because they provide a space for people to communicate with friends and peers or share information, and through websites and services that encourage and facilitate participation, social media allows a person to collaborate and build communities.

*B. Mean Scores on the Effectiveness of Technology Based Strategy*

Table 1.b shows the mean scores of the effectiveness of technology Based Strategy on knowledge of adolescents on diabetes mellitus. Based on post test results, there is an increase in the knowledge of adolescents in general (3.3032). Specifically, adolescents became fully knowledgeable in the nature (4.4967) and prevention (1.9313) of DM. Furthermore, it is also noted that there is an increase in the knowledge of the adolescents about the etiology (2.404), signs and symptoms and management of DM, although it was interpreted as moderate knowledge. There was an increase in the knowledge score of the subjects when comparing average pre-test and post-test score of 2.50384 and 3.30326 respectively.

TABLE 1.B MEAN SCORES OF THE EFFECTIVENESS OF TECHNOLOGY-BASED STRATEGY ON KNOWLEDGE OF ADOLESCENTS ON DIABETES MELLITUS

	Pretest	Interpretation	Posttest	Interpretation	
Nature	3.0769	Much Knowledgeable	4.4967	Fully Knowledgeable	T-test Value : 18.9541 Tabular Value: 2.132 Significant
Etiology	2.0513	Much Knowledgeable	2.402	Much Knowledgeable	
Sign and Symptoms	2.4615	Limited Knowledgeable	3.7288	Much Knowledgeable	
Management	3.2051	Much Knowledgeable	3.9575	Much Knowledgeable	
Prevention	1.7244	Fully Knowledgeable	1.9313	Fully Knowledgeable	
MEAN	2.5038	Limited	3.30326	Much	
	4	Knowledgeable		Knowledgeable	

The fully knowledgeable on the prevention even before the intervention was introduced can be explained that

questions regarding prevention are just basic lifestyle prevention regarding Diabetes Mellitus. Also, according to Arniella, G., et al (2015), adolescents acknowledged social support from friends and family for healthy behaviors. The respondents already had knowledge on the nature, etiology and management regarding DM on the pre-test because according to Al-Hussaini & Mustafa (2015) they have general information about DM.

The increase in the knowledge of adolescents about the nature, etiology, signs and symptoms, management and prevention of DM can be associated with the utilization of the digital medium, which is the blog site that talks about Diabetes Mellitus. Since the respondents were adolescents, students of the 21st century may retain more information if it comes to them through a digital medium, thus in a more digital world, online teaching tools are better for a student's memory [7]. Furthermore, Tsukayama, H. [9] also found out that the teens are spending more than one-third of their days using media such as online video or music, which is consistent with the findings of the family technology education non-profit group where teens spend nearly nine hours on average in the computer.

According to the Connectivism Theory of George Siemens, connectivism is the integration of principles explored by chaos, network, and complexity and selforganization theories. This assumes that learning is a process that occurs within the environment. Learning can reside outside of ourselves within the institution or database which is focused on connecting specific information sets. In this study, the researchers utilized technology-based strategy that serves as the network that provided information about DM for the respondents to generate new knowledge.

Another explanation for the increase in the knowledge of adolescents about DM was that the Technology Based Strategy contains all information related to the questions in the questionnaire. The blog site comprises nature, etiology, signs and symptoms, prevention and management of DM. Thus, the questionnaire has questions about nature on item numbers 1-6, item numbers 7-12 refers to signs and symptoms, item numbers 13-16 refers to etiology, item numbers 17-22 are management, and item numbers 23-24 refers to prevention. The reminders given by the researchers could also be contributory factors to the increase in knowledge of the adolescents.

The findings implied that in health care, the use of blog site is important innovation to the students since it can help increase knowledge or information about DM. Also, it can lessen the cases of DM among adolescents since they are now more informed about prevention, nature, etiology, management, signs and symptoms of DM. The information can be accessed faster since according to Tsukayama, H. [9] teens nowadays are spending one-third of their days using media.

It is interesting to note that the adolescents are fully knowledgeable about the prevention of DM even before accessing the blog site. This could be associated with Bandura's social learning theory, where they can learn from observation and imitation. The improved knowledge after accessing TBS could also be explained by the gradual process of including the contents of the blog site.

*C. Significant Difference in the Effectiveness of TBS According to Length of Access*

Table 2 shows the result of significant difference according to the length of access of the technology-based strategy. There was an increase observed on most of the categories. However, a decrease was observed in one of the categories which is the etiology

TABLE 2 SIGNIFICANT DIFFERENCE ACCORDING TO LENGTH OF ACCESS OF TECHNOLOGY BASED STRATEGY ON KNOWLEDGE OF ADOLESCENTS ON DIABETES MELLITUS

		3 Weeks		4 Weeks	T-test Value: -0.4621 Tabular Value: 2.776 Not Significant
Diabetes Mellitu	Mean	Interpretation	Mean	Interpretation	
Nature	4.3072	Much Knowledgeable	4.5359	Fully Knowledgeable	
Etiology	2.6144	Much Knowledgeable	4.5359	Much Knowledgeable	
Signs and Symptoms	3.228	Much Knowledgeable	3.7255	Much Knowledgeable	
Management	3.915	Much Knowledgeable	4.0327	Much Knowledgeable	
Prevention	1.8954	Fully Knowledgeable	1.9608	Fully Knowledgeable	
Total mean	3.192	Much Knowledgeable	3.332	Much Knowledgeable	

In the interpretation of table 2 below, a change was also noted specifically in the nature. From the interpretation of much knowledgeable (MK) on three weeks posttest to fully knowledgeable (FK) on four weeks posttest, the remaining four categories were still the same. The etiology remains as MK, signs and symptoms as MK, management as MK and prevention as FK. The t-test computed was -0.4621 at 4 degrees of freedom at 0.05 level of significance. Specifically, the result showed that longer duration of exposure to the TBS increased the knowledge of adolescents on diabetes mellitus. However, statistically, there was no significant difference on the length of access to the use of technology-based strategy. This means that even though the group utilized the blog site in 2 consecutive weeks (3 weeks and 4 weeks), there is no significant difference in between the two-time frame despite the slight increase in some of the categories of the technology-based strategy. This shows that the length of access has no or little effect on the use of a technology-based strategy in increasing the knowledge of adolescents. Although there were new topics introduced every day for the 3 weeks and 4 weeks use of the blog site, there is still no significant difference in the length of access in the use of technology-based strategy. In previous study, multimedia was used to a certain group of participants from October 2013 to August 2014 and the results showed that the implementation of multimedia diabetes education program, could improve patient's diabetes and insulin injection knowledge, insulin injection skills, self-efficacy in insulin injection and satisfaction with health education by Berry, et., Al. [10].

Another factor could be health status on viewing the blog. Our participants did not have the condition of having

diabetes mellitus, that's why, they might view frequently on the 3 weeks, but it could lessen their participation on seeing the blog on the 4 weeks. Some of their answers were based on their long-term and short-term memory. One aspect of the absence of significant difference on the length of access was that the youngest age group were rarely seen visiting in online site like website or blog site because of school activities such as examinations, assignments, projects and other extracurricular. These details were supported by the journal entitled "Social Media Use in the United States: Implications for Health Communication" by Hesse, et., Al. (2009). The youngest age group on their research was 18-24 years old. Our participants' age range was 15-18 years old, which is younger than those on the supporting journal. With this, we can also conclude that they may have a lesser attention span for using supporting online groups that can lead to the absence of significant difference to the length of access to the blog site.

However, according to Bhattacharyya, et., Al. [11], on their journal entitled "A web-based intervention to support self-management of patients with type 2 diabetes mellitus: Effect on self-efficacy, self-care and diabetes distress", participants were motivated to access their website on the basis of new blog postings daily in a week. From these results, there is a contradicting matter about the duration of the exposure to the blog site that may result to no significant difference on the length of access. Furthermore, it suggests that daily duration of access to the blog site can help the participants to internalize its contents. Since the adolescents of today have several factors that can affect their attention span such as being impatient, having more interest on graphical images that are not included in the blog site, tends to "read only" and sometimes, do not understand what they are reading, these can affect the views on the 4th week of exposure to the blog site. Moreover, even if the participants accessed the blog for only 3 weeks, it is obvious that they were able to grasp what DM is all about which implied more understanding of DM as they accessed the blog site in the 4 weeks' time.

According to Boveja, M.E. (2011), adolescents with authoritative parents in urban community tend to have more effective learning and studying strategies. In this research, several respondents from different provinces moved in Baguio City to study leaving their parents which tends them to be on their own. Because of this situation, it can affect the length of use of the blog site because their parents cannot support their children to access it.

*D. Significant Difference According to Groups*

Table 3 shows all over results between the brochure and technology-based strategy (TBS). Respondents under brochure had a mean score of 2.8570 indicated as less knowledge, while the respondents under technology-based strategy had a mean score of 3.2706 indicated as much knowledge. There was a significant difference in the mean ttest score. This difference indicates that the use of technology-based strategy is more effective in increasing the knowledge of the adolescents on the diabetes mellitus than the use of brochure.

TABLE 3 SIGNIFICANT DIFFERENCE ACCORDING TO TECHNOLOGY BASED STRATEGY GROUP AND BROCHURE GROUP

Diabetes Mellitu	TBS		Brochure		T –test Value: 5.0378 Tabular Value: 2.776 Significant
	Mean	Interpretation	Mean	Interpretation	
Nature	4.4216	Much Knowled geable	3.6900	Much Knowle dgeable	
Etiology	2.5522	Much Knowled geable	2.0900	Much Knowle dgeable	
Signs and Symptoms	3.4772	Much Knowled geable	3.2350	Much Knowle dgeable	
Management	3.9739	Much Knowled geable	3.5150	Much Knowle dgeable	
Prevention	1.9281	Fully Knowled geable	1.7550	Fully Knowle dgeable	
Total mean	3.2706	Much Knowled geable	2.8570	Limited Knowle dgeable	

The content of the technology-based strategy is same as the content of brochure, however, presented in a different way. Technology based strategy being an online system compared to brochure which is written. The adolescents' interest was higher in using technology to access learning to increase knowledge on diabetes mellitus, since the researcher was able to remind them to access the blog site for them to utilize it more frequently. Compared to brochure, they only read it ones and were not able to remind them to read it again. Today's young generation are greatly influenced by different technology and prefer to use technology as a source of learning. Today's youth have unprecedented access to modern technology and use them in expected and unexpected ways. Youth spend many hours a day using the technology, and the vast majority of them have access to Internet, cell phones, smart phone, video games and many more. Recent evidence raises concern about effects on academic performance [12]. A number of health information technology strategies are currently being used to manage diabetes [13]. The adolescents also learn from one another, since their generation mostly utilized the technology and other adolescents may imitate the behavior of using technology-based strategy to increase the knowledge on diabetes mellitus and can implement on their daily basis. According to Bandura's [14] Social learning theory people learn from one another, via observation, imitation, and modeling. He further states that observational occurs when an individual watch the behavior of the people around him/her.

For today's generation, students will prefer learning with the use of certain Internet services that enable more dynamic and online communications. Considerations encouraged the development of a new concept of learning theory built on the use of the potential of modern information and communication technologies, which has been designated as connectivism (Downes, 2012). There was increase in the TBS group because according to Siemen [15], learning is a process that occurs within the environment. Nowadays technology is within the environment of an adolescent. Therefore, this could be one

of the factors that increase the knowledge level of adolescents to DM. The Connectivism theory by George Siemens explains that network begins with a personal knowledge. Thus, the interdependence of learner and network address the challenges between the network (database) and the learner. In relation to the experimental group, they were directed to the blog site which contains the information about the DM. They were regularly updated to read updates. In this situation, the adolescents were able to read the correct information regarding to diabetes which also leads to the increase knowledge on DM.

The key aspect of teaching conceived is the creation and the maintenance of interconnection on the network, expanding the knowledge base of the individual beyond his or her own capacity. That is why constructivist methods, involving the process of active social learning have been gradually applied recently in order to build a proper learning network and to internalize basic knowledge structures, including further deepening of the knowledge gained by the educate (Klement, M., et al, 2015). Advantages of technology based strategy consists in saving time, individualizing instruction, objective feedback and usability not only for teaching but also for the transmission of information, in which the emphasis is on their way transmission. (Sedivy & Jan Chromy, 2015). The didactic use of Internet features and capabilities is necessary for teaching the use of certain capital assets to ensure transmission of information between the sender and recipient (Chromy & Drtina, 2012).

#### IV. LIMITATIONS

In the blog site, the researchers were able to determine the views or the numbers of persons who visited. However, the researchers were not able to determine or monitor the specific respondents who accessed the blog site. The researchers were not also sure that the respondents consistently visited the blog site because the views show that there is inconsistent number of views. Moreover, some respondent refreshed and/ revisited the blog site, it adds per number of views per page. Since the total respondents are 153, the researchers noted that there is an increase in the number of views. The length of access was changed from 1 and 2 weeks to 3 and 4 weeks because the blog site was given on time due to revisions that were made.

#### V. CONCLUSION

The use of technology-based strategy or blog site is effective in increasing the knowledge of the adolescent regarding DM in terms of nature, etiology, signs and symptoms, management, and prevention and it is more effective than the use of brochure. The three weeks exposure of respondents to the TBS yielded an increase of knowledge regarding DM. On the fourth week, it showed an increase of knowledge, however, statistically, there is no significant difference in the effectiveness of the TBS according to the length of exposure to the TBS. Through the t-test computation results, it was found out that there is a significant difference in the effectiveness of TBS according to groups with a t-test value of 5.0378 that indicates a significant difference at .05 level of confidence. TBS group showed higher results compared to that of the brochure group. Through the utilization of the experimental group to

TBS, it showed a significant difference in the effectiveness of TBS on DM compared to the control group that utilized the brochure. The TBS is an appropriate and adolescent friendly strategy for increasing knowledge on DM.

For the millennial adolescents, the use of a technologybased strategy like a blog site is one of the appropriate strategies to build awareness about health and health-related matters. This may include devices such as phones, laptops, and iPods that can be used for information, entertainment and communication. This information can be used for public and can be shared according to the times such as WhatsApp, Instagram, Facebook etc.

#### RECOMMENDATION

The study findings will serve as a basis for the development of appropriate learning materials taking into consideration the characteristics of respondents and learning management systems. Respondents should be updated regularly, and information must be contained in the TBS. Follow up or remind respondents to visit the blogsite regularly. Improve the site to encourage more readers or clients of any age. In future research, health status can be included as one variable, in determining effectiveness of a technology-based strategy on adolescents' knowledge on DM. The use of teachable applications can be used as a strategy to monitor participation in the blog site.

#### REFERENCES

- [1] International Diabetes Federation, "IDF Diabetes Atlas 7th Edition Brussels, Belgium," *idf.org*. 2015.
- [2] Targa T, P. RRS, and S. MGC, "From diagnosis to unknown: perceptions of parents of children and adolescents with diabetes mellitus," 2017.
- [3] A. Ramachandran, "Trends in prevalence of diabetes in Asian countries," *World J. Diabetes*, 2012. [4] O. R. Temneanu, L. M. Trandafir, and M. R. Purcarea, "Type 2 diabetes mellitus in children and adolescents: a relatively new clinical problem within pediatric practice," *Journal of medicine and life*. 2016.
- [5] V. L. Franklin, A. Waller, C. Pagliari, and S. A. Greene, "A randomized controlled trial of Sweet Talk, a text-messaging system to support young people with diabetes," *Diabet. Med.*, 2006.
- [6] N. Fischetti, "Correlates among perceived risk for type 2 diabetes mellitus, physical activity, and dietary intake in adolescents," *Pediatric Nursing*. 2015.
- [7] M. Granito and E. Chernobilsky, "The Effect of Technology on a Student 's Motivation and Knowledge Retention," *NERA Conf. Proc.* 2012, 2012.
- [8] A. A. Garcia, E. T. Villagomez, S. A. Brown, K. Kouzekanani, and C. L. Hanis, "The Starr County Diabetes Education Study: Development of the Spanish-language diabetes knowledge questionnaire," *Diabetes Care*, vol. 24, no. 1, pp. 16–21, 2001.



- [9] Hayley Tsukayama, "Teens spend nearly nine hours every day consuming media - The Washington Post," *Novemb.* 3, p. 3, 2015.
- [10] M. C. Huang, C. H. Hung, C. Y. Yu, D. C. Berry, S. J. Shin, and Y. Y. Hsu, "The effectiveness of multimedia education for patients with type 2 diabetes mellitus," *J. Adv. Nurs.*, 2017.
- [11] C. H. Yu *et al.*, "A web-based intervention to support selfmanagement of patients with type 2 diabetes mellitus: Effect on self-efficacy, self-care and diabetes distress," *BMC Med. Inform. Decis. Mak.*, 2014.
- [12] M. Simuforosa, "The impact of modern technology on the educational attainment of adolescents," *Int. J. Educ. Res.*, 2013.
- [13] H. Riazi, B. Larijani, M. Langarizadeh, and L. Shahmoradi, "Managing diabetes mellitus using information technology: A systematic review," *J. Diabetes Metab. Disord.*, 2015.
- [14] A. Bandura, "Social Learning Theory of Aggression," *J. Commun.*, 1978.
- [15] G. Siemens, "Connectivism: A learning theory for the digital age," *Int. J. Instr. Technol. Distance Learn.*, 2005.