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DOES TECHNOLOGY REALLY HELP DIGITAL NATIVES? A FUZZY STATISTICAL ANALYSIS AND EVALUATION OF STUDENTS' LEARNING ACHIEVEMENTS

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ABSTRACT. *In this paper, we investigate the effect of using technologies common to digital natives on the learning achievements of elementary school students. The factors we consider include time, content of activity, time of learning, search technique, and internet safety. We use fuzzy statistics with a soft methodology to analyze the fuzzy data. The results show that school children spent an average of 3.23 days a week on the internet, at an average of 2.14 hours per session. On average, 32.84 minutes were spent looking up school-related information, and the most frequent activity was playing online games. There was great success in learning in the subject of "Social Studies and Science and Technology". We emphasize to both teachers and parents the need to pay more attention to how schoolchildren use the internet, the study habits of the students regarding information on the internet, and the need to provide children with the appropriate skills to navigate the internet and learn from it.*

Keywords: Digital Natives; Fuzzy Statistical Analysis; Internet Technologies

1. Introduction. In the age of the knowledge-economy, the measurement of the value of intellectual achievement is increasingly receiving more and more attention. However, the evaluation of students' achievement is complex, it involves many factors, such as peoples' utility (human subjective recognition) and the students' development etc. that are very difficult to calculate by traditional methods. In this paper we propose an integrated fuzzy evaluation procedure to evaluate the students' achievement. The primary main methods used are fuzzy statistical analysis, fuzzy-weighting and fuzzy ranking. This integrated procedure is aimed at yielding appropriate and reasonable rank and value of intellectual capital. We also give empirical examples to illustrate the techniques and how to evaluate it.

Internet, instant messaging in a time of highly advance technologies, some call it the N-Generation, D-Generation, S-Generation or “Digital Natives”. Digital Natives are referring to the “mother tongue” used by this new generation is a product of new thinking and data process derived from using computer and internet. Digital Natives use extensive digital media that allows fast, multiple, illustrative, random access to storage module, this makes the leaning method used by Digital Natives different from the teaching methods used by teachers (Pernsky, 2007; Mayer and Moreno, 1998; Clark and Mayer, 2003).

Online-based learning patterns have modified the traditional roles of learner and teacher as learner’s learning method is changed because of information technology, online-based system should place more emphasis on teaching quality and learning effectiveness of online learning environment, Roblyer and Knezek (2003).

Implementing computer hardware is only the beginning, the key is the ability to apply, actual effectiveness of computer relies on the application of online resources, school children of digital natives have become accustom to using extensive information materials; however, are these school children spending too much time on internet and what sort of activities they often engage online? What type of internet ethical issues they have to face? There are fewer documentations targeting how school children use internet after school, therefore this research will specifically study this topic and the findings could be used as reference materials by education institutions.

According to the 2010 “Taiwan Broadband Network Usage Study” conducted by Taiwan Network Information Center, as of February 12, 2010, there is about 16.22 million internet users in Taiwan, a total of 16,217,009 people had used internet, TWNIC (2010). Internet has become part of people’s daily activities, through the various functions of internet, learning new knowledge, recreation, reading information or shopping have been made possible. Internet changes how people interact with each other, especially transforming the way people communicate. The growth of internet and networking technologies introduces the development of email, instant messaging and video messaging that lead to new learning pattern or life style.

In this research, we incorporate the concept of fuzzy statistic to explore and analyze how school children use internet with an aim to promote the planning of computer information education courses at schools. Major objectives of this research are as follows:

(1) Analysis on the frequency, time school children use internet for school works.
(2) Analysis on the activities school children often engage online.
(3) Explore the Satisfaction of students for learning information to be used for information education course planning.

2. Fuzzy Evaluation on the Students’ Achievement.

2.1. System Investigation. Based on the main objectives of this research, analysis was performed on frequency, time of using internet for school works among school children. Figure 1 illustrate our research map.

We had observed the fact that many school children often spent time on using internet after school, since many researches had pointed out that internet has significant effect on life, school works and cognitive skills as the result of school children using internet. In addition to formal computer course at school, most school children use internet at home, adults from a number of families would limit the use of internet by their children while some families would not interfere the use of internet devices by their children.

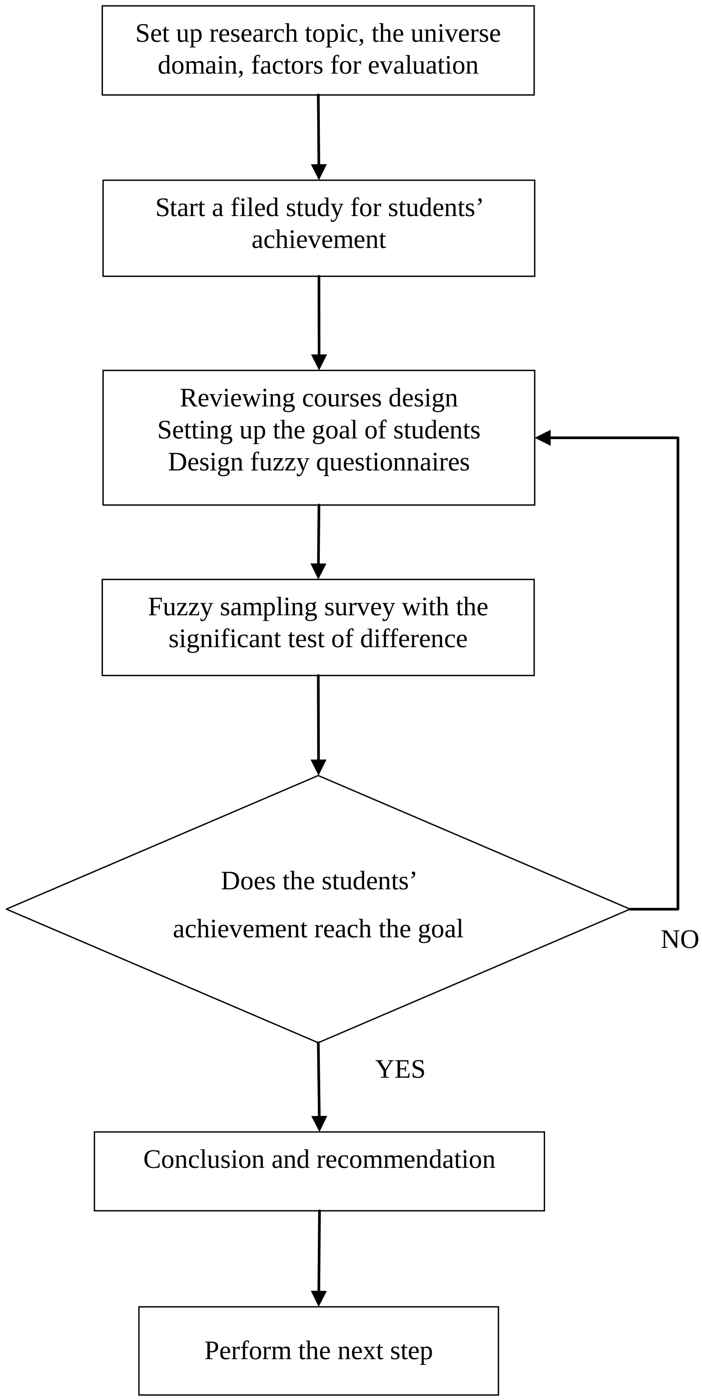

FIGURE 1. A flow chart of research

Figure 2 demonstrates the relations about the courses design and student achievement.

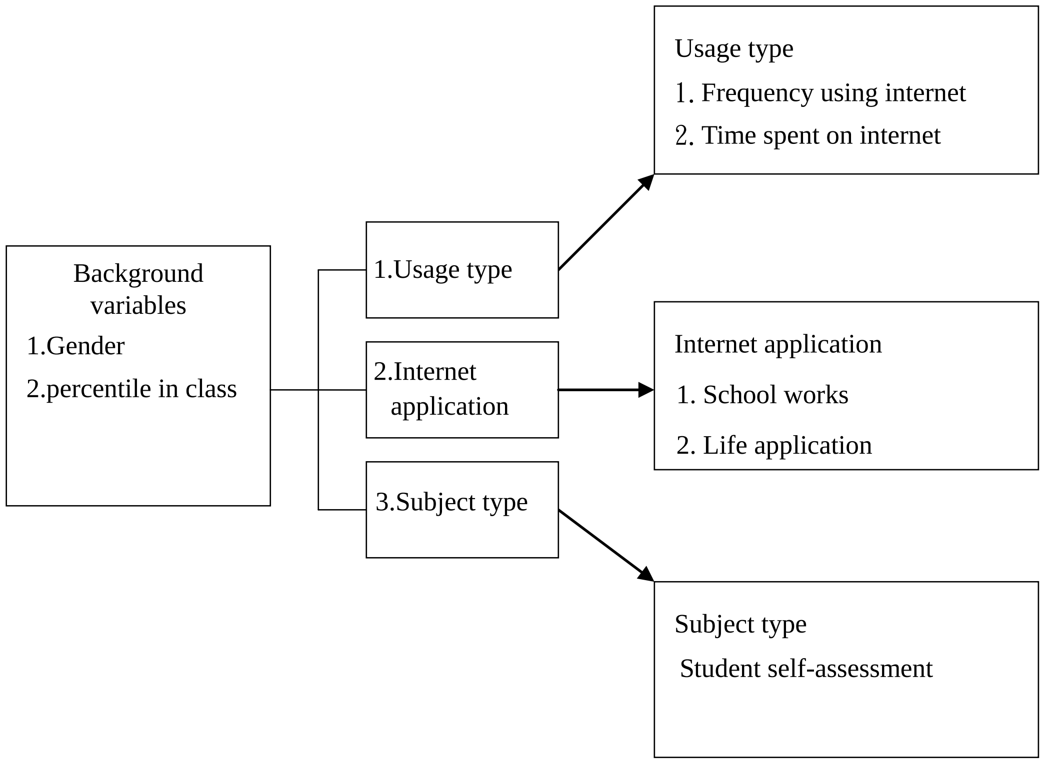

FIGURE 2. Detailed students achievement design and evaluation

2.2. Application with Fuzzy Set Theory. Human beings have a nonlinear but emotional thinking process, traditional questionnaire would be difficult to have people elaborate on their thoughts at a deeper level. For example, research questionnaire often like to include “like” in the question. Liking something is an internal feeling, other than everyone has a different level of feeling, sometimes a pendulum effect could occur resulting in different answers, how much could someone elaborate on the extent of liking something? What would be the percentage that such feeling occupy a person’s mind?

Social science aims to study the internal motivation or feeling of human behaviors, traditional quantifiable statistics almost require the subject to express a single motivation or feeling and attempt to apply definitive quantified statistics to display abnormal behaviors of human beings and analyze psychological measurements from a probability perspective, mathematical pattern actually simplified complex issue, nevertheless the complicated subjective point of view and thinking were usually overlook, Wu (2005), Nguyen and Wu (2006).

Motivations that propel human behaviors often change with time, environment, age or stage of life, moreover sometimes human thinking or decision process is filled with great leaps, uncertainty or fuzzy, nonlinear and incoherent as they might be determined by the judgment and dynamic thinking towards certain subject at the moment.

In 1965, Zadeh first introduced the concept of fuzzy set, using fuzzy logic as basis, made a breakthrough from the traditional mathematic binary logic to a dichotomy method distinguishing right and wrong, this argument is based on the fuzzy measurement and classification principle of human brain activity in a dynamic environment thus giving a more moderate solution to a fuzzy phenomenon of multiple-levels, this argument was explained in great details in the research of Lowen (1990), Ruspini (1991), Dubois and Prade (1991).

Zedah (1999) went even further to recommend the use of perception measure and soft computing system as fuzzy function for measurement. Simplified dichotomy method is really unable to accurately describe the multiple nature of human behavior, therefore we consider using fuzzy classification in table analysis to resolve the problem of excessive simplification. Concepts such as fuzzy average, fuzzy median and fuzzy mode in basic descriptive statistics are incorporated to present the research findings of human behavioral statistics, Wu (2000).

Membership grade function is the most basic concept in fuzzy theory, it is derived from the characteristic function of traditional set and it is used for expressing an element's membership grade in a fuzzy set, its range is between 0 and 1. It is not only able to describe the characteristics of fuzzy set, it is also able to quantify fuzzy set while using accurate mathematic method to analyze and process information of fuzzy nature. Membership grade function could be classified as discretization and continuous. Discretization type membership grade function directly assign membership grade to each element in a limited fuzzy set and present the result in a vector format. Continuous type membership grade function could use several frequently used functions to describe a fuzzy set, please refer to Zimmermann (1991) for the various types of membership grade functions.

Membership grade functions can not escape individual subjective consciousness, therefore there is no common theory or formula, confirmation is usually achieved through experience or statistics Wu (2005). For example, activities online to school children, might be favored by them, however there would be difference in the extent of how much they like it. Research subjects like online games the most, time was also spent on chatting or making friend through network system, email is another favorite function of internet. With the design of fuzzy statistic questionnaire, research subjects were allowed to express the extent of how much they like certain activity and assign a percentage of such enjoyment in their mind, this could be presented in percentage or total sum value. In other words, the concept of membership grade was used, a total value of fuzzy statistic equal to 1 was obtained. Thanks to questionnaire based on fuzzy theory, this research was able to accurately reflect the true feeling of individual answering the questionnaire, allowing research subjects to fully express what feel inside, therefore the data received in the questionnaire were able to represent the meaning and value of this research.

3. Fuzzy Statistics. Traditional statistics deals single answer or certain range of the answer through sampling survey, and unable to sufficiently reflect the complex thought of an individual. If people can use the membership function to express the degree of their feelings based on their own choices, the answer presented will be closer to real human thinking. Therefore, to collect the information based on the fuzzy mode should be the first step to take. Since a lot of times, the information itself embedded with uncertainty and ambiguity. It is nature for us to propose the fuzzy statistics, such as fuzzy mode and fuzzy median, to fit the modern requirement. In this and next section we demonstrate the definitions for fuzzy mode and fuzzy median generalized from the traditional statistics. The discrete case is simpler than the continuous one's.

Definition 3.1. Fuzzy sample mean (data with multiple values).

Let U be the universal set (a discussion domain), $L=\{L_1,L_2,\cdots,L_k\}$ be a set of k-linguistic variables on U, and $\{Fx_i=\frac{m_{i1}}{L_1}+\frac{m_{i2}}{L_2}+...+\frac{m_{ik}}{L_k}, i=1,2,...,n\}$ be a sequence of random fuzzy sample on U, $m_{ij}(\sum_{j=1}^{k} m_{ij}=1)$ is the memberships with respect to L_j .Then, the Fuzzy sample mean is defined as

$$F\overline{x}=\frac{\frac{1}{n}\sum_{i=1}^{n}m_{i1}}{L_1}+\frac{\frac{1}{n}\sum_{i=1}^{n}m_{i2}}{L_{i2}}+...+\frac{\frac{1}{n}\sum_{i=1}^{n}m_{ik}}{L_k} \quad (1)$$

Example 3.1. Let the x_1 =[2,3], x_2 = [3,4], x_3 = [4,6], x_4 = [5,8], x_5 =[3,7] be the beginning salary for 5 new master graduated students. Then fuzzy sample mean for the beginning salary of the graduated students will be

$$F\overline{x}=[\frac{2+3+4+5+3}{5},\frac{3+4+6+8+7}{5}]=[3.4,\ 5.6] \quad (2)$$

Definition 3.2. Fuzzy sample mode (data with multiple values).

Let U be the universal set (a discussion domain), $L=\{L_1,L_2,\cdots,L_k\}$ a set of k-linguistic variables on U, and $\{FS_i, i=1,2\cdots,n\}$ a sequence of random fuzzy sample on U. For each sample FS_i, assign a linguistic variable L_j a normalized membership $m_{ij}(\sum_{j=1}^{k} m_{ij}=1)$, let $S_j=\sum_{i=1}^{n} m_{ij}$, $j=1,2,\cdots,k$. Then, the maximum value of S_j (with respect to L_j) is called the fuzzy mode (FM) of this sample. That is $FM=\{L_j \mid S_j=\max_{1\le i\le k} S_i\}$.

Note: A significant level α for fuzzy mode can be defined as follows: Let U be the universal set (a discussion domain), $L=\{L_1,L_2,\cdots,L_k\}$ a set of k-linguistic variables on U, and $\{FS_i, i=1,2\cdots,n\}$ a sequence of random fuzzy sample on U. For each sample FS_i, assign a linguistic variable L_j a normalized membership $m_{ij}(\sum_{j=1}^{k} m_{ij}=1)$, let $S_j=\sum_{i=1}^{n} I_{ij}$, $j=1,2,\cdots,k$ $\quad I_{ij}=1\ if\ m_{ij}\ge\alpha,\ I_{ij}=0\ if\ m_{ij}<\alpha$, α is the significant level. Then, the maximum value of S_j (with respect to L_j) is called the fuzzy mode (FM) of this sample. That is $FM=\{L_j \mid S_j=\max_{1\le i\le k} S_i\}$. If there are more than two sets of L_j that reach the conditions, we say that the fuzzy sample has multiple common agreement.

Definition 3.3. Fuzzy sample mode (data with interval values).

Let U be the universal set (a discussion domain), $L=\{L_1,L_2,\cdots,L_k\}$ a set of k-linguistic variables on U, and $\{FS_i=[a_i,b_i],a_i,b_i\in R,i=1,2,\cdots,n\}$ be a sequence of random fuzzy sample on U. For each sample FS_i, if there is an interval [c, d] which is covered by certain samples, we call these samples as a cluster. Let MS be the set of clusters which contains the maximum number of sample, then the fuzzy mode FM is defined as

$$FM=[a,b]=\{\cap[a_i,b_i]\,\|\,[a_i,b_i]\subset MS\} \quad (3)$$

If $[a,b]$ does not exist (i.e. $[a,b]$ is an empty set), we say this fuzzy sample does not have fuzzy mode.

Example 3.2. Suppose eight voters are asked to choose a chairman from four candidates. Table 1 is the result from the votes with two different types of voting: traditional response versus fuzzy response.

TABLE 1. Response comparison for the eight voters

Candidate	Traditional response				Fuzzy response			
Voter	A	B	C	D	A	B	C	D
1		∨				0.7	0.3	
2	∨				0.5		0.4	0.1
3				∨			0.3	0.7
4			∨		0.4		0.6	
5		∨				0.6	0.4	
6				∨	0.4		0.4	0.6
7		∨				0.8	0.2	
8			∨				0.8	0.2
Total	1	3	2	2	1.3	2.1	3.5	1.6

From the traditional voting, we can find that three are three person vote for B. Hence the mode of the vote is B. However, from the fuzzy voting, B only gets a total membership of 2.1, while C gets 3.4. Based on traditional voting, B is elected the chairperson, while based on the fuzzy voting or membership voting, C is the chairperson. The voters' preference isreflected more accurately in fuzzy voting, C deserves to be the chairperson more than B does.

Fuzzy χ^2-test of homogeneity (with discrete data).

Consider a K-cell multinomial vector n={$n_1, n_2, ..., n_k$} with $\sum_i n_i = n$. The Pearson chi-squared test ($\chi^2=\sum_i\sum_j\frac{n_{ij}-e_{ij}}{e_{ij}}$) is a well known statistical test for investigating the significance of the differences between observed data arranged in K classes and the theoretically expected frequencies in the K classes. It is clear that the large discrepancies between the observed data and expected cell counts will result in larger values of χ^2

However, a somewhat ambiguous question is whether (quantitative) discrete data can be considered categorical and use the traditional χ^2-test. For example, suppose a child is asked the following question: "how much do you love your sister?" If the responses is a fuzzy number (say, 70% of the time), it is certainly inappropriate to use the traditional χ^2-test for the analysis. We will present a χ^2-test for fuzzy data as follows:

Procedures for Testing hypothesis of homogeneity for discrete fuzzy samples.

(1) Sample：Let Ω be a domain，$\{L_j, j=1,...,k\}$ be ordered linguistic variables on Ω, and $\{a_1, a_2, \cdots, a_m\}$ and $\{b_1, b_2, \cdots, b_n\}$ are random fuzzy sample from population A, B with standerized membership function mA_{ij}, mB_{ij}.

(2) Hypothesis: Two populations A, B have the same distribution ratio. i.e

$$H_0 : F\mu_A =_F F\mu_B$$

Where

$$F\mu_A = \frac{\frac{1}{m}MA_1}{L_1} + \frac{\frac{1}{m}MA_2}{L_2} + ... + \frac{\frac{1}{m}MA_k}{L_k}$$

$$F\mu_B = \frac{\frac{1}{n}MB_1}{L_1} + \frac{\frac{1}{n}MB_2}{L_2} + ... + \frac{\frac{1}{n}MB_k}{L_k}$$

$$MA_j = \sum_{i=1}^{m} mA_{ij} \text{ , } MB_j = \sum_{i=1}^{n} mB_{ij} \text{ .}$$

(3) Statistics： $\chi^2 = \sum_{i\in A,B}\sum_{j=1}^{c}\frac{([Mi_j]-e_{ij})^2}{e_{ij}}$. (In order to perform the Chi-square test for fuzzy data, we transfer the decimal fractions of Mi_j in each cell of fuzzy category into the integer Mi_j by counting 0.5 or higher fractions as 1 and discard the rest.)

(4) Decision rule：under significance level α, if $\chi^2 > \chi^2_\alpha(k-1)$,then we reject H_0.

Procedures for Testing hypothesis of homogeneity for interval fuzzy samples.

(1) Sample：Let Ω be a discussion domain, $\{L_j, j=1,...,k\}$ be ordered linguistic variables on the total range of Ω，and $\{a_i = [a_{li}, a_{ui}], i=1,...,m\}$ } and $\{b_i = [b_{li}, b_{ui}], i=1,...,n\}$ and are random fuzzy sample from population A, B with standardized membership function mA_{ij}, mB_{ij}.

(2) Hypothesis: Two populations A, B have the same distribution ratio. i.e

$$H_0 : F\mu_A =_F F\mu_B$$

Where

$$F\mu_A = \frac{\frac{1}{m}MA_1}{L_1} + \frac{\frac{1}{m}MA_2}{L_2} + ... + \frac{\frac{1}{m}MA_k}{L_k}, \quad F\mu_B = \frac{\frac{1}{n}MB_1}{L_1} + \frac{\frac{1}{n}MB_2}{L_2} + ... + \frac{\frac{1}{n}MB_k}{L_k}$$

$$MA_j = \sum_{i=1}^{m} mA_{ij} \text{ , } MB_j = \sum_{i=1}^{n} mB_{ij} \text{ .}$$

(3) Statistics： $\chi^2 = \sum_{i\in A,B}\sum_{j=1}^{c}\frac{([Mi_j]-e_{ij})^2}{e_{ij}}$. (In order to perform the Chi-square test for fuzzy data, we transfer the decimal fractions of Mi_j in each cell of fuzzy category into the

integer Mi_j by counting 0.5 or higher fractions as 1 and discard the rest.)

(4) Decision rule：under significance level α, if $\chi^2 > \chi^2_\alpha(k-1)$, then we reject H_0.

Example 3.3. DDP party wants to know the degree of support from an election. Suppose they are interested in how the sex will make a difference about the voting. They conduct a sampling survey and ask the people with two methods for reply: traditional reply and fuzzy reply. The result is as follows:

TABLE 2. Replies for peoples on the degree of party support

	Support of Parties			χ^2 -test of homogeneity	Support of parties			χ^2 -test of homogeneity
Category	DDP	KMT	others	χ^2 =8.27 > 5.99 = $\chi^2_{0.05}(2)$	DDP	KMT	others	χ^2 =3.78 < 5.99 = $\chi^2_{0.05}(2)$
Male	220	280	100		216.2	268.5	114.3	
Female	170	150	80		158.1	154.7	87.2	

Null Hypothesis: H_0：there is no difference of the degree of support for parties. H_1: there is no difference of the degree of support for parties. Under the significance level α =0.05, we can find that there exists difference Statistical testing conclusion: for traditional reply, we will reject the null hypothesis. While for the fuzzy reply, will accept the null hypothesis.

Example 3.4. In order to set up a sales strategy, the R&D of a supermarket manger want to know the living expense(monthly) between community X and community Y. They randomly choose 50 samples from X and Y. during the answering process, people are asked to write their living expense by interval instead of real number. For instance, they can write the living expense as: 1500~2500 with membership 0.7, 2500~4000 with membership 0.3. Then they sum up the memberships and get the following Table 3.

TABLE 3. Monthly living expense for community X and Y

	0~1500	1500~2500	2500~4000	4000~6000	6000+
X	2.8	10.3	19.7	14.2	5.0
Y	7.1	21.6	20.9	6.8	2.6

Null Hypothesis H_0：The distribution (ratio) for living expense between is no difference. H_1：community *X* has a higher living expense than *Y*.

Computing the statisitcs χ^2, we find χ^2 =8.43> $\chi^2_{0.05}(4)$ =7.78. Hence under the significant level α =0.1. We reject H_0：The distribution (ratio) for living expense between is no difference. Examining again the data, we may say that the community *X* has a higher living expense than community *Y*.

4. Empirical Studies and Findings. Methods that evaluate social behaviors include interview, observation, paper test, this research had adopted paper test, research subjects were given various questions for answering in order to obtain the data needed in this research. 6 questions were in the questionnaire, they were all to be completed by fuzzy answers, research subjects were 6th grade school children from certain elementary school in Houlong town of Miaoli county, instructions were given by the researcher before questionnaire were handed out. 55 sets of questionnaire were handed out, 55 sets were returned, valid questionnaires were 55. Return rate was 100%. Analysis on the descriptive statistics of sample structure is as in Table 4.

TABLE 4. Descriptive statistics of samples

Background variables		Frequency	Percentage
Gender	Girl	24	43.6
	Boy	31	56.4
Average percentile in class of current semester	1~5	9	16.4
	6~10	12	21.8
	11~15	10	18.2
	16~20	13	23.6
	21~25	7	12.7
	26~	4	7.3
whether Parent interfere activities online	yes	40	72.7
	no	15	27.3
Whether parents use internet	yes	43	78.2
	no	12	21.8

Out of the 55 research subjects, boys were the majority accounting for 56.4%; average percentile in class was 16-20 accounting for 23.6%; research subjects with parents interfering activities online was actually 72.7%; and parents that also use internet was 78.2%.

4.1. Usage Condition. The condition of how school children use internet after school was analyzed from the time spent online and frequency, the results are as follow:

Frequency analysis on school children using internet in a week. Statistical findings were as shown in Table 5.Average number of days school children use internet in a week is 3.23 days, if gender was taken into consideration, boys were 3.84 days, girls were 2.63 days.

Analysis on the time spent by school children on internet after school. Statistical findings showed the average time spent by all school children on internet after school was 2.14 hours, if gender was taken into consideration, boys were 2.26 hours, girls were 2.02 hours.

4.2. Internet Applications. Applications of internet used by school children after schools were examined in terms of school related works, life application, the findings were as follows:

Analysis on the time spent by school children on internet for school related works.

Statistical finding were as shown in Table 7. Average time spent by school children on internet for school related works after school was 32.84 minutes, if gender was taken into consideration, boys were 28.39 minutes, girls were 37.29 minutes.

TABLE 5. Frequency analysis on school children using internet in a week

Unit: Days

	Fuzzy average	Fuzzy median	Fuzzy mode
All childrens（N=55）	3.23	1.75-3.50	1-2
Boys（N=31）	3.84	2.00-4.00	
Girls（N=24）	2.63	1.50-3.00	

TABLE 6. Analysis on the time spent by school children on internet after school

Unit: Hour

	Fuzzy average	Fuzzy median	Fuzzy mode
All childrens（N=55）	2.14	1.00-3.00	1-2
Boys（N=31）	2.26	1.00-3.00	
Girls（N=24）	2.02	1.00-3.00	

TABLE 7. Analysis on the time spent by school children on internet for school related works

Unit: Minutes

	Fuzzy average	Fuzzy median	Fuzzy mode
All childrens（N=55）	32.84	1.00-3.00	20-30
Boys（N=31）	28.39	20.00-30.00	
Girls（N=24）	37.29	20.00-50.00	

TABLE 8. Analysis on the activities school children often engage online

	Fuzzy average	Fuzzy median	Fuzzy mode
1.Send/receive e-mail	0.13	0.10	0.05
2.Play online games	0.38	0.35	0.40
3.Chat,making friends	0.21	0.19	0.30
4.Look up information online	0.17	0.13	0.15
5.Looking up for homework	0.11	0.09	0.10

TABLE 9. Analysis on the significance of Grades regarding the activities school children engage online

Test of homogeneity	grades	1	2	3	4	5	
H_0 : Whether grades would make any difference on the activities school children engage online	1~5	10.56	38.33	28.33	13.89	8.89	χ^2 =38.69 $>$ 28.41= $\chi^2_{0.1}(20)$ Reject H_0
	6~10	14.17	33.25	25.08	16.25	11.25	
	11~15	11.00	44.50	17.00	19.90	7.60	
	16~20	11.38	46.69	19.77	12.69	9.46	
	21~25	13.86	35.29	8.86	22.29	18.14	
	26~	24.75	30.25	14.75	16.50	14.00	

4.3. Subject Type. Regarding course of learning area on the self-assessment for school children, Table 10 is the result from school children make use of fuzzy response for learning area. Most of the distributions lie in satisfaction, “Social Studies and Science and Technology”. “English” was the least.

Activities school children often engage online. Statistical findings are as shown in Table 8. “Play online games” had the highest fuzzy average, the lowest was “Looking up for homework”.

TABLE 10. Analysis on the satisfaction of learning area for school children

Learning Area	Very satisfied	Satisfied	Dissatisfied	Very dissatisfied
Mandarin	18.37	43.29	28.11	10.23
Mathematics	10.89	37.13	40.22	11.76
Social Studies	38.46	37.22	15.78	8.54
Science and Technology	44.21	31.23	19.19	5.37
English	3.29	12.48	32.12	52.11

5. Conclusion. This research is to examine how school children of digital native generation use internet technology after school. Based on the findings, We discovered that average number of days school children spent on internet in a week is 3.23 days, 2.14 hours per day. As for frequency and amount of time, most numbers for boys were greater than those of girls. Time used for looking for home work information was 32.84 minutes, girls spent more time in this area than boys did. “Play online games” was the most frequent activities school children engaged online, on the other hand “looking up for home work” was the least. grades of school children played significant part in online activities.

Internet technology is a daily tool for those in the digital native generation, they use it in daily life, for recreation, looking up information and school works. However, it still takes appropriate to education guide elementary school children in using internet technology and learning information. For example, it was learned that school children spent as long as 2.14 hours on internet after school but only about half hour was used for studying, the rest of time was spend on playing online games. Therefore, teachers and parents should pay more attention to school children in order to better understand how them spend children time on online and the type of activities.

Result shows that fuzzy statistics with soft computing are more realistic and reasonable in the students' achievement. Finally certain comments are suggested for the further studies. We propose the following suggestions: (1). strengthen fundamental education on internet technology for school children, teaching them to make better use of the convenience and technology brought by internet; (2). provide needed educational information to parents to assist them children for after school online activities; (3). place emphasis E-Learning of Mandarin and Mathematics and English.

REFERENCES

[1] B. L. Wu (2000), Modren Statistics, *Chien Chen Taipei*.

[2] B. L. Wu (2005), Introduction to fuzzy statistics: method and applications, *Wunan Taipei*.

[3] D. Dubois and H. Prade (1991) , Fuzzy sets in approximate reasoning, Part 1: Inference with possibility distributions, *Fuzzy Sets and Systems*, vol.40, pp.143-202.

[4] E. Ruspini (1991) Approximate Reasoning: past, present, future, *Information Sciences*, vol.57, pp.297-317.

[5] H. J. Zimmermann (1991), Fuzzy Set Theory and Its Applications, *Boston: Kluwer Academic*.

[6] H. T. Nguyen and B. L. Wu (2006), Fundamentals of statistics with fuzzy data, *New York: Springer*.

[7] L. A. Zedah (1999), Fuzzy Sets, *Information and Control*, vol.8, pp.338-353.

[8] M. Prnsky (2001), Digital natives,digital immigrants,*On the Horizon*, vol.9, no.5, pp.1-6.

[9] M. D. Roblyer and G .A. Knezek (2003) , New millennium research for educational technology:A call for a national research agenda, *Journal of Research on Technology in Education*, vol.36, no.1, pp.60-71.

[10] R. C. Clark and R. E. Mayer (2003), E-Learning and the science of instruction. *San Francisco, CA:Pfeiffer*.

[11] R. Lowen (1990) A fuzzy language interpolation theorem. *Fuzzy Sets and Systems*, vol.34, pp.33-38.

[12] R. E. Mayer and R. Moreno (1998), A splitattention effect in multimedia learning: Evidence for dual processing systems in working memory, *Journal of Educational Psychology*, vol.90, no.2, pp.312-320.

[13] TWNIC (2010), TWNIC 2010 Taiwan's broadband Internet use survey, *from http://stat.twnic.net.tw/*.