



ISSN: 2319-5967

ISO 9001:2008 Certified

International Journal of Engineering Science and Innovative Technology (IJESIT)

Volume 3, Issue 4, July 2014

# Measuring instrument learning styles to optimize the teaching of mathematics in university students

Rosa Graciela Castro Carrera, Magally Martínez Reyes

*Abstract— The following paper proposes the development and construction of a student model for a virtual education system applied to so those student characteristics that affect the learning process in mathematics courses will be modeled at a higher level; assigning each user the more attached to his personal characteristics and needs and then listing, update this information through interaction with the system itself. For creation of the student model took into account the various parameters proposed in the literature including learning style is the constant in the models. Learning styles are characterized by representing the behavior of each person in the learning process and determine how to use a strategy and method for learning; so this is one of the main variables of our model. With this variable the first classification of the profiles of student learning is done. The following article shows how to discover the predominant learning styles among students to absorb a strategy independent and individualized learning special, using the test designed by Felder and Silverman (2004, Index of Learning Styles (ILS)) for it. Test results applied to students in this way to personalize learning and provide students with the most suitable to their profile in order to achieve better student achievement study strategies are presented.*

*Index Terms— Learning styles, Student model, Student profile.*

## I. INTRODUCTION

In University Center Valle of Chalco have reported some problems learning in the subjects related to the area of mathematics, test scores are mostly disapproving. The educational model applied, is competence based instruction but it is the traditional way; i.e it follows the seeing the teacher as the focus of the teaching, he decides what and how to learn the student, the same information to a group of students is not operated taking into account their individual characteristics, so that; as stated [7], education must adapt their structures and teaching methods to new requirements to provide a participatory and creative education where they take into account each student because they are different and therefore have different ways of thinking and grasp information.

The information technology and communication have contributed to universal access to education; this has allowed the free development of cognitive activities in various areas of study and aimed at students with different levels of knowledge. Virtual education provides a platform for an easy access to information and educational content currently have tried to build virtual education systems involving the behavior of students among which we mention the intelligent tutoring systems (ITS), they have tried to simulate a human tutor and optimize the learning process of each student to customize [8]. To accomplish this, the systems require a module called student model, which is a fundamental part of ITS since it represents the state of knowledge of the student [3].

The student model should contain information such as a description of the individual student knowledge, learning skills, personal strengths and weaknesses. When you want to create a model to represent and guide a student there are different features to consider, one of which is the learning style [2]. We observed and analyzed the different models of the student in the ITS (see Table I) and we find that a constant in all of them is that characteristic by which this work will focus on the use of an instrument designed to assess learning styles to understand behaviors of students in the teaching-learning process and define the type of action that may be more effective at a given time. The model of learning styles Felder is one of the most widely cited papers regarding the topic models.

## II. MATERIALS AND METHODS

All theories of learning styles offer an instructional and psychological basis, but not all approach pedagogical principles being sought. Models based on constructivism can be very useful among which the most widely tested are those proposed by Mumford, Dunn and Dunn and Felder [1]. The most appropriate model for this project is



ISSN: 2319-5967

ISO 9001:2008 Certified

International Journal of Engineering Science and Innovative Technology (IJESIT)

Volume 3, Issue 4, July 2014

proposed by Ferder and Silverman (FSLSM) for their wide application in educational systems and in the field of Engineering and Computer Science. The first proposal made in 1988, had 10 learning styles students specifically identified in the area of engineering. In 2001 Felder reduced model only 8 learning styles.

The Felder and Silverman model [6], allows to categorize students according to their ability to process, collect, receive, organize and understand information and classifies learning styles from four dimensions, which are related with the answers that can be obtain the following questions;

1. Which type of information perceived better student? Sensory or Intuitive?
2. What mode through which most effectively perceived sensory information? Visual or Verbal?
3. How the student prefers to process information perceived? Active or reflexive?
4. How does the student understand? Sequential or Global?

The FSLSM model has been the outcome of a research project many years. It was designed with dichotomous dimensions that may be particularly important when applied to the field of education sciences and computer assisted learning. From these approaches Richard Felder developed an instrument, the Index of Learning Styles (ILS) in 1996 supported the work of Felder and Silverman in 1988 this model has certain similarities with three other models of learning styles. Kolb model and other two models, one based on the Myers-Briggs indicator and the other a Herrmann instrument application based on the specialization of the hemispheres of the brain [9]. Felder's model is a mixed model that includes some other learning styles models.

At this stage of the project we worked on the validation of the instrument collection ILS data, which is based on a questionnaire of 44 questions that inquire about behaviors, attitudes and preferences of students in certain situations or circumstances [5], of this way to get students rated with the profile of initial learning or cognitive parameters under four scales (active / reflective, sensory / intuitive, visual / verbal, sequential / global). These dimensions are based on the most important within the field of learning styles considered, and are independent of each other. This instrument allows categorizing students according to their ability to process, collect, receive, organize and understand information.

Under these principles the learning styles test to 31 students of the University Center Valle of Chalco Career Computer Engineering fifth semester was applied; of which 30% are women and 70% are men between 19 and 21 years old. Was also applied to students of the Telesecundaria Emperador Cuauhtemoc No.598 second grade; 50% of them are men and 50% are women aged between 13 and 14, giving a total of 43 people. With the aim of obtain information on the characteristics, attitudes and behaviors of the individual student and determine the preferred way of learning.

Data collection began with a pilot group of 12 students Telesecundaria Emperor Cuauhtemoc No.598 in order to make adjustments to the data collection instrument, its implementation allowed us to determine that the 91.7% of participants understood the information requested (see Table II), this situation offered the feasibility of collecting information with the entire population under investigation (31 students studying computer engineering).

Felder and Silverman (1988) describe learning styles using scales ranging from 11 to -11 points for each dimension (including only odd values). Should be noted that Felder and Silverman (2001) consider preferences and trends, that is, even a student with a strong preference for a particular learning style can act some / many times differently. The preference for each dimension is expressed as the result of the responses ("a" or "b") at 11 which define issues. The 11 questions that define each dimension are dichotomous (if you answer the letter "a" in the eleven questions get -11, and if you answer "b" will be 11). The result is the subtraction of responses "b" responses "a" and can vary, as mentioned, between -11 and 11.

- Negative ratings refer to active, sensory, visual and sequential style.
- Scores positive opposites in every dimension; reflective, intuitive, verbal and global.
- The scores are interpreted according to three levels of priority: low, medium and high.
  - A score between -3 and 3 (-3 to -1 and from 1 to 3) indicates a low or balanced preference.
  - A score -7 to -5 and 5 to 7 show a preferred medium.



ISSN: 2319-5967

ISO 9001:2008 Certified

International Journal of Engineering Science and Innovative Technology (IJESIT)

Volume 3, Issue 4, July 2014

- A score between -11 to -9 of 9-11 high preference.

If each student has a particular combination of preferences and abilities; the end thrown particular learning style (see Table III).

The data collection instrument was developed under a web platform and object-oriented programming with Java; student records are stored in a MySQL database (see Fig. 1, 2 and 3).

### III. RESULTS AND DISCUSSION

To identify the preferred learning style of each student, the Learning Styles Inventory Felder and Silverman scored, considering the highest score of the four bipolar response scales (Active-Reflective, Sensory-Intuitive, Visual-Verbal and sequential-Global).

The questionnaires were administered in a single session that lasted about 30 minutes. The results from this survey are shown in Table 3, here the learning styles of students and the preference for each recital preference 3 ranks are represented, so you can see that for the style:

- Active - Reflective, 25 of 43 students have an appropriate balance, 17 have a moderate preference, y 1 a very strong preference to assets (see Table IV). For this type of style is to be of the 43 students are more active than reflective, it can be seen that are 31 to 12 active and reflective in both cases most have an appropriate balance.
- Sensory - Intuitive, in this style were obtained, 27 students with balanced preference, 14 moderate and 2 with very strong preference towards the sensitive preference. This profile can be noted that 29 of the 43 students more intuitive sense that because of the latter are only 14, which in both cases most have a balanced preference (see Table V).
- Visual - Verbal, 20 students have an appropriate balance, 14 moderate and 9 preferably a strong preference for the visual (see Table VI). Here we see that the majority of students present balanced and moderate preference, tend more toward the visual than verbal.
- Sequential - Global, most of the students belong to the range between the balanced preference, taking 23 of 43; moderate preference in 16 and only 4 with high preference towards it Sequential. Moreover it can also be seen clearly that are sequential standard because it has 29 to 14 students (see Table VII).

As for the computer system, primarily the collection of personal data of the student and then test the application of learning styles in order to thus obtain the student's learning profile is which will optimize the learning process of each students considering teaching strategies that suit their learning preferences.

When the student enters the system for the first time, it must provide personal information such as full name, account number, race, date of birth, gender and email. Personal data are aspects that identify each student in the system. These data are static and unique, the user capture once through a registration form (see Fig 1), which is also asked to enter a username and password, this is subsequently used it to enter the system from the "system Login" page (see Fig 2). Once I provide the user data and start meeting should begin the test of learning styles (see Fig 3). When you finish answering the test, you will provide the same results, indicating the learning strategy best suited to their preferences (see Fig 4).

#### A. Tables and Figures

Table I Comparative student models

VARIABLES / AUTHOR	González (2008)	Santos (2009)	Cataldi (2012)	Vélez (2009)	Huapaya (2009)	Barrientos (2012)	Conejo (2001)	Peña (2005)
Personal information	*	*	*	*	*	*	*	*
Emotional state	*	*						



ISSN: 2319-5967

ISO 9001:2008 Certified

International Journal of Engineering Science and Innovative Technology (IJESIT)

Volume 3, Issue 4, July 2014

Environmental Context	*								
<b>Learning styles</b>	*	*	*	*	*	*	*	*	*
Personality	*	*							
Academic History	*		*	*				*	
Level of competition				*	*	*	*		
Psychological profile	*		*						
History of use of the system		*	*	*	*	*	*	*	*

Table II Percentage of participants who understood the information requested

Tiempo en responder test	Total de alumnos	Porcentaje de alumnos
8- 10 minutos	11	91.7%
11 - 15 minutos	1	8.3%

Table III. Learning Styles obtained

Learning Style	Points obtained								
	Preference Balanced 1-3			Preference Balanced 1-3			Preference Balanced 1-3		
	Men	Men	Men	Men	Men	Men	Men	Men	TOTAL
<b>Active</b>	10	5	<b>15</b>	9	6	<b>15</b>	1	0	<b>1</b>
<b>Reflexive</b>	7	3	<b>10</b>	1	1	<b>2</b>	0	0	<b>0</b>
<b>Sensory</b>	11	6	<b>17</b>	7	3	<b>10</b>	2	0	<b>2</b>
<b>Intuitive</b>	5	5	<b>10</b>	5	4	<b>9</b>	0	0	<b>0</b>
<b>Visual</b>	10	5	<b>15</b>	8	4	<b>12</b>	7	2	<b>9</b>
<b>Verbal</b>	3	2	<b>5</b>	2	0	<b>2</b>	0	0	<b>0</b>
<b>Sequential</b>	7	6	<b>13</b>	11	2	<b>13</b>	2	1	<b>3</b>
<b>Global</b>	5	5	<b>10</b>	3	0	<b>3</b>	0	1	<b>1</b>
<b>TOTALES</b>	58	37	<b>95</b>	46	20	<b>66</b>	12	4	<b>16</b>

Table IV Result Active – Reflective

Learning Style	Points obtained								
	Preference Balanced 1-3			Media Preference 5-7			Added Preference 9-11		
	Men	Women	TOTAL	Men	Women	TOTAL	Men	Women	TOTAL
<b>Active</b>	10	5	<b>15</b>	9	6	<b>15</b>	1	0	<b>1</b>
<b>Reflexive</b>	7	3	<b>10</b>	1	1	<b>2</b>	0	0	<b>0</b>
	17	8	<b>25</b>	10	7	<b>17</b>	1	0	<b>1</b>

Table V Result Sensitive – Intuitive

Learning Style	Points obtained								
	Preference Balanced 1-3			Media Preference 5-7			Added Preference 9-11		
	Men	Women	TOTAL	Men	Women	TOTAL	Men	Women	TOTAL
<b>Sensitive</b>	11	6	<b>17</b>	7	3	<b>10</b>	2	0	<b>2</b>
<b>Intuitive</b>	5	5	<b>10</b>	3	1	<b>4</b>	0	0	
	16	11	<b>27</b>	10	4	<b>14</b>	2	0	<b>2</b>

Table VI Result Visual - Verbal

Learning Style	Points obtained								
	Preference Balanced 1-3			Media Preference 5-7			Added Preference 9-11		
	Men	Women	TOTAL	Men	Women	TOTAL	Men	Women	TOTAL
<b>Visual</b>	10	5	<b>15</b>	8	4	<b>12</b>	7	2	<b>9</b>
<b>Verbal</b>	3	2	<b>5</b>	2	0	<b>2</b>	0	0	<b>0</b>
	13	7	<b>20</b>	10	4	<b>14</b>	7	2	<b>9</b>



ISSN: 2319-5967

ISO 9001:2008 Certified

International Journal of Engineering Science and Innovative Technology (IJESIT)

Volume 3, Issue 4, July 2014

Table VII Result Sequential – Global

Learning Style	Points obtained								
	Preference Balanced 1-3			Media Preference 5-7			Added Preference 9-11		
	Men	Women	TOTAL	Men	Women	TOTAL	Men	Women	TOTAL
Sequential	7	6	13	11	2	13	2	1	3
Global	5	5	10	3	0	3	0	1	1
	12	11	23	14	2	16	2	2	4

**Formulario de Registro**

Insertar

Nombre:

Contraseña:

Repite Contraseña:

Numero de Cuenta:

Calificacion :

nacimiento:

sexo:

email:

Carrera:

**Registrar**

Fig. 1 Registration Form Student Data

**UAEM** | Universidad Autónoma del Estado de México

Si eres usuario nuevo da click aquí.

**Inicio de sesion**

**Menu**

Numero de Cuenta:

Contraseña:

**Ingresar**

Fig. 2 Login System



ISSN: 2319-5967

ISO 9001:2008 Certified

International Journal of Engineering Science and Innovative Technology (IJESIT)

Volume 3, Issue 4, July 2014




## Estilo de Aprendizaje



### Test

1. Entiendo mejor algo:
  - Si lo practico.
  - Si pienso en ello.
2. Me considero:
  - Realista.
  - Inovador.
3. Cuando pienso acerca de lo que hice ayer, es más probable que lo haga sobre la base de:
  - Una imagen.
  - Palabras.
4. Tengo tendencia a:
  - Entender los detalles de un tema pero no ver claramente su estructura completa.
  - Entender la estructura completa pero no ver claramente los detalles.
5. Cuando estoy aprendiendo algo nuevo, me ayuda:
  - Hablar de ello
  - Pensar en ello
6. Si yo fuera profesor, yo preferiría dar un curso:
  - Que trate sobre hechos y situaciones reales de la vida
  - Que trate con ideas y teorías
7. Prefiero obtener información nueva de :
  - Imágenes, diagramas, gráficas o mapas
  - Instrucciones escritas o información verbal
8. Una vez que entiendo:
  - Todas las partes, entiendo el total.
  - El total de algo, entiendo como encajan sus partes

Fig. 3 Learning Styles Test

Pedro
PERFIL POST TEST METODOS DE APRENDIZAJE

## Resultados de 2020

Activo-Reflexivo	Sensitivo-Intuitivo	Visual-Verbal	Secuencial-Global
<p>Usted presenta un equilibrio apropiado entre los estilos Activo- Reflexivo. Este tipo de alumnos adquiere el conocimiento cuando hacen algo activo con la información (discutiéndola, aplicándola, explicándosela a otros) y a veces prefieren aprender meditando, pensando y trabajando solos a través de la reflexión o introspección por medio de memorias, ideas, lecturas, etc.</p>	<p>Usted presenta un equilibrio apropiado entre los estilos Sensitivo - Intuitivo. Este tipo de estudiantes perciben la información de dos maneras: información externa o sensitiva a la vista, al oído o a las sensaciones físicas y la información interna o intuitiva a través de memorias, ideas, lecturas, etc. Les gusta resolver problemas con procedimientos muy bien establecidos, tienden a ser pacientes con detalles; gustan de trabajo práctico además son imaginativos y aprenden con abstracciones y formulaciones matemáticas.</p>	<p>Usted presenta un equilibrio apropiado entre los estilos Visual - Verbal Con respecto a la información externa, los estudiantes básicamente la reciben en formatos visuales mediante cuadros, diagramas, gráficos, demostraciones, entre otros, o en formatos verbales mediante sonidos, expresión oral y escrita, fórmulas, símbolos.</p>	<p>Usted presenta un equilibrio apropiado entre los estilos Secuencial - Global. El progreso de los estudiantes sobre el aprendizaje implica un procedimiento secuencial que necesita progresión lógica de pasos incrementales pequeños o entendimiento global que requiere de una visión integral.</p>

**Numero de cuenta: 202020**

**Nombre: Pedro**

Tipo de usuario: ALUMNO

E-mail: skaoz@hotmail.com

Fecha de nacimiento: 1991-06-11

Sexo: M

Carrera: ICO

Calli Diagnostico: 0.0

Fig. 4 Results Styles Test



ISSN: 2319-5967

ISO 9001:2008 Certified

International Journal of Engineering Science and Innovative Technology (IJESIT)

Volume 3, Issue 4, July 2014

#### IV. CONCLUSION

It is useful to determine the students' learning profile to bring the planning, strategies and guide the learning of each student. The prototype system shows a more efficient way of collecting data and when applied manually response time is between 20 and 30 minutes processing information to determine learning style is between 2 and 3 minutes for each questionnaire with no change in the system allows for a capture process by students between 10 and 15 minutes and the results are immediately displayed showing the student what kind of learning style defined and what information is the most suitable for use school.

#### ACKNOWLEDGMENT

I thank the Autonomous University of the State of Mexico Valle of Chalco and Dr. Martinez Reyes Magally for their support and collaboration in the writing of this paper

#### REFERENCES

- [1] A. Peña, "Un modelo del estudiante basado en mapas cognitivos," Tesis Doctoral Instituto Politécnico Nacional Centro de Investigación en Computación, 2007.
- [2] H. González, N. Duque and D. Ovalle, "Modelo del Estudiante para Sistemas Adaptativos de Educación Virtual," III Congreso Colombiano de Computación, Medellín, 2008.
- [3] J. Vélez, "Entorno de Aprendizaje Virtual Adaptativo Soportado por un Modelo de Usuario Integral," Tesis Doctoral Departamento de Arquitectura y Tecnología de Computadores Universidad de Girona, 2009.
- [4] M. Jiménez, "Modelo de Evaluación Adaptativa del Nivel de Conocimientos del Estudiante para Sistemas Tutoriales Inteligentes," 2009.
- [5] N. Loaiza and A. Guevara, "Los estilos de aprendizaje: una propuesta pedagógica para optimizar la enseñanza de las lenguas extranjeras en la licenciatura en lenguas modernas de la universidad del Quindío," 2012.
- [6] R. Felder and L. Silverman, "Learning and Teaching Styles in Engineering Education, *Engr. Education*," 78(7), 674-681, 2001.
- [7] S. Ramos, J. González and S. Hernández, "Los sistemas de tutoría inteligente y el aprendizaje," 2º Encuentro de Tutorías de la Región Centro Occidente, 2010.
- [8] Z. Cataldi and F. Lage, "Modelado del Estudiante en Sistemas Tutores Inteligentes," *Revista Iberoamericana de Tecnología en Educación y Educación en Tecnología*. Buenos Aires, Argentina, 2012.
- [9] M. Rodríguez, "Fortalecer estilos de aprendizaje para aprender a aprender," *Revista Estilos de Aprendizaje*, no11, Vol 11, República Argentina, 2013.

#### AUTHOR BIOGRAPHY



**Castro Carrera Rosa Graciela:** Computer engineer, professor at the Autonomous University of the State of Mexico Center Valle of Chalco and student of Masters in computer science. The area of emphasis of his research is educational technology more specifically artificial intelligence on Education Systems, analysis of the student model in intelligent tutoring systems.



**Magally Martinez Reyes:** PhD in Mathematics Education at the Center for Research and Advanced Studies (CINVESTAV) and Head of the Office of Management at the Autonomous University of the State of Mexico Center Valle of Chalco. The area of emphasis of his research is educational technology. She is part of the National System of Researchers (SNI).