

A hypothesis about the relationship between learning styles and academic self-efficacy.

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Resumen: La población estudiada muestra una tendencia predominante hacia el estilo de aprendizaje activo y bajos niveles de autoeficacia académica. El artículo expone una hipótesis sobre el por qué no se obtienen los resultados esperados, aun cuando la enseñanza se diseñó tomando en cuenta el estilo de aprendizaje que predomina. Se demuestra la necesidad de profundizar en la influencia que puede ejercer el nivel de autoeficacia académica de una persona en la manifestación de las características propias del estilo de aprendizaje hacia el cual revela una tendencia predominante.

Palabras clave: Estilos de aprendizaje; Cuestionario CHAEA; Autoeficacia académica; Escala de autoeficacia académica; Rendimiento académico

Abstract: The studied population shows a predominant trend toward active learning style and low level of academic self-efficacy. The article presents a hypothesis about why learning results did not correspond with the expected one, even when the teaching was designed taking into account the learning style that predominates; promoting the need to deepen on the influence that can exert the level of academic self-efficacy of a person, in the manifestation of the characteristics of learning style towards which reveals a predominant trend.

Keywords: Learning styles; CHAEA questionnaire; Academic self-efficacy; Academic self-efficacy scale; Academic performance.

Introduction

Nowadays, there are different models and theories related to learning styles which, from different points of view, offer a conceptual and explanatory framework about the behavior of a person who is learning, and the type of didactic action that is more effective for them at a given moment while learning. Among the most known and used models related to learning styles there are some like Kolb's, the one about the brain hemispheres, Blader and Grinder's neuro-linguistic programming, and Gardner's theories about multiple intelligence.

In this work, the authors assume the model of Kolb, and the ideas developed by Honey-Mumford and Honey-Alonso, which consider that optimum learning requires four stages: experimenting, reflecting, theorizing and acting. In general, all these stages are not implemented in the same way

in all subjects during the learning process, even in few cases, one of the stages is predominant. Certainly, the predominant stage characterizes the way of learning of an individual; this is the reason for calling these predominant stages: learning styles of the subject. Generally, it can be observed that there are four basic learning styles: pragmatic, reflexive, theoretical and active. Finally, it should be emphasized that there are some subjects in whom one of the previous stages is predominant.

The real life situation of the learning styles theory reveals enough empirical and theoretical material for declaring that the design and development of teaching harmonize with the learning styles of the students; independently, the model of learning style assumed by the authors influence positively in the success of the process. The writers of this work have developed some teaching- learning experiences that support the veracity of the suggested thesis.

Taking into account those antecedents a study was designed, related to a general unit corresponding to the Course Foundations of School Mathematics 1 , taught in the first year of the Mathematics-Physics pedagogical major at the Guantanamo University in Cuba. The results of systematic assessment and the first partial evaluation, related to the achievement of the learning objectives, allowed us to established two significant elements, but these elements were not in correspondence with the expected results:

- Lack of a coherent behavior of the students in the development of learning activities and the characteristics described in the literature for persons identified with a predominant tendency towards the active learning style, when considering the perspective of the model of Kolb.
- Poor results on the evaluation of the students, indicating an insufficient level of achievement of the students' acquisition of knowledge.

In the search for an explanation about the situation already described, the authors have studied the construct of academic self-efficacy in a group of students; this search led to determine some elements to be taken into consideration for explaining the stated contradictions.

This article presents a hypothesis about some reasons for those results, emphasizing on the need of deepening on the influence that the level of academic self-efficacy of a subject can have in the manifestation of the personal characteristics of his/ her predominant learning style.

Development

A descriptive study of the learning styles and the level of academic self-efficacy was carried out with first year students of the Mathematics-Physics Pedagogical Major at the University of Guantanamo in Cuba, during the year 2015-2016. Then a second topic was considered (academic self-efficacy) after realizing that the evaluation of the results of the students was not in correspondence with the expected outcomes.

During the first semester of the year 2015-2016 a study of the basic unit of Numerical Domains was designed and implemented, it was centered in the Course of Foundations of School Mathematics 1 for the first year of the major in the process of training future teachers of Mathematics and Physics.

The syllabus of the year establishes that the study of this theme must contribute to solve the difficulties that affect students when they begin studying the subject at University. Besides, they need training to figure out the solutions to exercises and problems related to their performance and knowledge related to teaching.

In the program of study it is established that the necessary system of knowledge comprehends Algebra; Properties: associativity, commutativity, and element inverting possibility; Numerical Domains (\mathbb{N} , \mathbb{Z} , \mathbb{Q}^+ , \mathbb{Q} , \mathbb{R} , \mathbb{C}); Decimal Numerical System; Prime and compound numbers; Number's decomposition in prime factors; Minimum Common multiple and common maximum dividend; The set of fractional numbers; Order and operations in \mathbb{Q}^+ ; The concept of fraction and its practical meaning; Decimal expressions; Reading and writing decimal expressions up to a million; Representing numbers in the numerical axis; Limitations and necessity for expansion; Order and operations; The domain of integer numbers; Limits, order and operations; Criteria about the divisibility in \mathbb{Z} ; The rational numbers; Limitations and the necessity of extending, ordering and operating; Scientific representation; The real numbers; Limitations and necessity for expansion; Order and operations; Combinatory theory; The complex numbers; Order and operations; and Solving arithmetic problems.

Once the real life situation of the students regarding their competence for facing the new contents of the units is diagnosed, the teaching learning process of the subject is implemented, taking into account the application of the Honey-Alonso questionnaire about learning styles (Questionnaire

CHAEA) which demonstrated that the students registered in the course were classified with a predominant tendency towards the active learning style.

This type of subjects, described by Alonso, Gallego and Honey (2012), is characterized for being: encouraging, innovative, risky, spontaneous, creative, protagonist, willing, participatory, and competitive; these subjects enjoy solving problems and are always trying to learn something new.

When designing the main units, the experts' opinion regarding learning styles about the educational process was considered; it confirmed that the subjects with a predominant tendency towards the active learning style will successfully learn when they try new experiences, do presentations, solve problems as part of a team, develop a variety of activities, actively participate in real situations, take risks, find solutions for problems or demanding difficulties, try some different things, talk with other subjects with similar behavior, which do not involve being seated for a long time, and other recommendations. (Manzano, 2007; Alonso, Gallego and Honey, 2012)

Taking into account the previous elements, the dynamics for the study of the main unit Numerical Domains was structured by setting two working teams, each composed of three students; these teams should develop, as an important component of the independent work, the study of the subject, and answer five types of tasks:

- Task 1. Review of the contents of the previous level necessary for achieving the learning objectives declared on the syllabus of the year.
- Task 2. Solve demanding mathematical exercises and problems that are included on the texts used in previous levels for the study of Numerical Domain.
- Task 3. Presenting new learning after observing and analyzing video materials related with the main unit.
- Task 4. Presentation of the acquired knowledge after the search in Internet of contents related to the main unit.
- Task 5. Resolving exercises and problems that demand the knowledge of the object of study of the main unit.

The systematic observation of the students' performance acknowledged: lack of enthusiasm for developing homework, lack of involvement, skepticism with the possibility of succeed in given

tasks that should be developed in an independent way, fear to failure, among other characteristics that were not described in the literature for subjects with a predominant tendency for active learning. After developing the two first tasks, all the students failed in the first partial evaluation, and this fact indicates that the learning objectives were not achieved.

Motivated by that situation, and knowing that good results in the learning process were also due to a successful use of the resources, the investigators confirmed the previously mentioned thesis, also stated by Barraza (2010), Gakyia and Cássia (2009), among others. The authors of this article set out as task the investigation about the level of academic self-efficacy as “the convictions of the students about their own capacity for developing the academic activities demanded by the school” (Barraza, 2010 p.4).

For the study of this construct there was used the Academic Self- Efficacy Scale presented in doctoral thesis by the Spanish professor Juan Carlos Torres, who, according to Morales (2012) on his initial valuation registered a reliability of 0.903.

The Academic Self- Efficacy Scale consists on nine items that express trust and security an academic success, evaluated by five options for answering, organized from less to more. The options to answer are: nothing to do with me (1), something to do with me(2), is true is my situation most of the time(3), it is closely related with me(4), it is my personal case(5). Now the nine affirmations of the Scale are:

- 1- I consider myself with enough capacity to overcome all the subjects of the year.
- 2- I have trust to understand everything the professor is going to explain in the lessons.
- 3- I am confident in my strength to go forward on the year.
- 4- I am sure that I will understand the most difficult contents explained in the year.
- 5- I feel prepared to solve the exercise and problems in the lessons.
- 6- When somebody asks me to do work and homework at home, I am sure that I will do it well.
- 7- I feel prepared from the academic point of view.
- 8- I am convinced that I will pass the final exams.

- 9- Considering all my personal features, I consider that I have all the resources to fulfill my studies in the University.

The obtained marks of a subject in each item will be added to make 9 to 45 points. Consequently, this final mark will be the level of academic self-efficacy reached by the subject, the level will be consider low: if the mark is between 9 and 15 points; moderate: if the mark is between 16 and 30 points and high if it is between 31 and 45 points.

The data was implemented by the software package SPSS, version 21. The processing consisted on: characterizing the population taking into account age, sex, learning styles, level of academic self-efficacy; the coefficient of reliability Alpha of Cronbach analysis, and the T test for students which analyses the significant differences among the marks reached by the population of students of each learning style.

Analysis of the learning styles and the level of academic self-efficacy in a population of students.

The population, object of study was created by a group of six students registered in the course Foundations of Mathematics in the School I (2015-2016), from this sample two (33,3%) were feminine and four (66,7%) were masculine. The ages of the participants were between 18 and 20. The average age was of 18, 33 with a deviation of 1,03 years.

The questionnaire CHAEA was answered by the six students, and as a result there was a coefficient of reliability Alfa of Cronbach with a 0,916 for the whole instrument; these results in correspondence with Morales's criteria (2007) were considered highly valuable for the internal strength of the instrument. The next table contains the marks reached by the students after they answered the questionnaire by Honey Alonso, related with learning styles (CHAEA). In the table could be observe that the best mark is always in the same column that is about the active learning style.

Subject	Marks of the Active Style	Marks of the Theoretical Style	Marks of the Reflexive Style	Marks of the Pragmatic Style
Subject 1	16,00	15,00	6,00	10,00
Subject 2	17,00	14,00	11,00	14,00
Subject 3	12,00	9,00	7,00	6,00
Subject 4	14,00	9,00	7,00	9,00
Subject 5	18,00	16,00	16,00	17,00

Subject 6	18,00	13,00	9,00	15,00
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Table 1. Marks reached by the students after answering the questionnaire.

Source: Own elaboration

The evaluation of the results allowed specifying in terms of relative and absolute frequency, the predominant level of the learning style according to the Model of Kolb, the ones that are in the following table.

Type of learning style	Absolute Frequency	Average
Active	6	100,00%
Reflexive	0	0,00 %
Theoretical	0	0,00 %
Pragmatic	0	0,00 %

Table 2. Distribution of the students according to the types of learning styles.

Source: Own elaboration.

As you can see in the previous table, the evaluated students were characterized by a predominant tendency toward the active learning style.

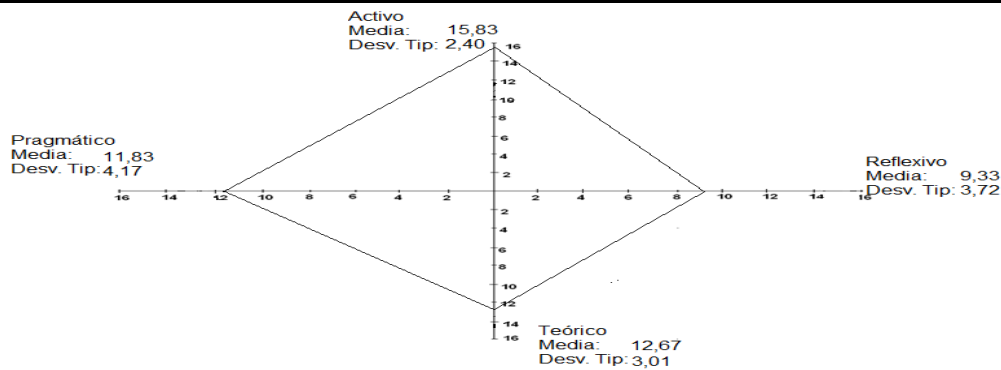
The next table contains the average marks and the common deviation reached in each of the types of learning styles.

Type of learning style	Average Mark.	Typical Deviation
Active	15,83	2,40
Reflexive	9,33	3,72
Theoretical	12,67	3,01
Pragmatic	11,83	4,01

Table 3. The average marks and the common deviation reached in each of the types of learning styles.

Source: Own elaboration.

Starting by these marks, the learning profile of the group of students shows a greater pronouncement toward the active learning style axis, and the axis corresponding to the reflexive learning style shows less pronouncement; please look at the following graphic.



Graphic 1. Learning profile of the population of students from the Course.

The pronouncement toward the axis corresponding to the active learning style, observed in the graphic 1, induces to think in the predominant character of the learning style in the group of students. Besides, there was made an analysis of the significant differences between the average marks reached in each learning style. For that reason there was used the T test of student in two independent groups, previous to the analysis of the differences of the average corresponding to the six pairs of possible combinations between the four learning styles: active and reflexive, active and theoretical, active and pragmatic, reflexive and pragmatic, and theoretical and pragmatic.

The Kolmogorov-Smirnov Test allowed, with a 95% of trust, the accomplishment of the normal differences among the corresponding average between active and reflexive style ($p: 0,003$), active and theoretical ($p: 0,005$), active and pragmatic ($p: 0,004$), reflexive and theoretical ($p: 0,045$); and to obtain the hypothesis of no existence of the significant differences among the average marks of the reflexive and pragmatic ($p: 0,053$) and, theoretical and pragmatic ($0,474$); in all the developed analysis there was considered a level of trust with a 95%.

The results previously exposed, allowed to deduce that the investigated students were manifesting a predominant tendency toward the active learning style.

It is important to point out that all the works developed by the investigators about the students of the year realize that they have a predominant tendency towards the reflexive learning style (Beatriz, 2015; Bocciolesi y Rosati, 2015). Even, in the consulted literature there was some research in which the authors declared that the new students in the University have developed

some learning strategies related with active and pragmatic style. (Ordóñez y otros, 2003; Beatriz, 2015).

Other way, there is the Academic Self-Efficacy Scale, also applied to six students of the group, giving a trust coefficient Alfa de Cronbach of 0,701, for the whole instrument. The results of the Scale application are in the following table, this table contains the marks and the academic self-efficacy level manifested in each of the students.

Subject	Final Marks	Academic Self-Efficacy Level
1	11	low
2	12	low
3	10	low
4	14	low
5	14	low
6	11	low

Table 4. The marks and the academic self- efficacy level manifested in each of the students.

Source: Own Elaboration

After analyzing the previous table, according with the final marks, all the students will be characterize by a low level of academic self- efficacy.

Finally, the application of the CHAEA questionnaire and the Academic Self-Efficacy Scale allowed finishing that the six students of the group could be characterized as students with a predominant tendency to the active learning and a lower level of academic self-efficacy.

A hypothesis about the reasons for the obtained results during the development of the learning experience.

The self-efficacy belief constitutes a cognitive mechanism that acts as the mediator between the knowledge and practice through the different actions that could be developed with the acquired knowledge, these actions together with the different variables contribute to the achievement of the objective of those same actions.

In the theoretical core of the Bandura's theory, systematized by Barraza (2010), he assumed that among the elements, the belief of a personal efficacy becomes mediator in the effect of the environment conditions over people's behavior, this means, that those person with a high level of self-efficacy expectation may confront successfully these conditions.

Those self-efficacy expectations were characterized by determination of the effort that the person used for doing a given task, the time they devoted to those efforts and the persistence to face difficult situations. The subject with a high level of self-efficacy expectation confront tasks with optimism and interest, getting more success than those subjects with a low level of self-efficacy expectation, these subjects react with pessimism, anxiety and depression toward the challenged tasks. (Barraza 2010).

Especiallly, in the educative context, students with a high level of self-efficacy expectation show, the ability of doing satisfactorily educative tasks, besides they evaluate their own performance, opposite to those with a low level of self-efficacy. From the Bandura's point of view a successful learning process depends of the convictions that the subject have, and the ability to control different cognitive, affective and willing aspects, these aspects will determine the result of the behavior; avoiding and overcoming the difficult conditions of the activity environment.

The consulted literature, contains some Empirical works related with links and relations between learning styles, academic self efficacy and the students' achievements; but there were emphasizing on the relation academic self efficacy and the students' achievements. Generally, all these works coincide in that academic self efficacy is an important point for the students' achievements, even more than other variables.

The authors showed a particular interest for the investigation of Torres (2010). As main results of the author's investigation, with the nine grade students on the Secondary School in Braga, revealed that academic self-efficacy in Portuguese Language and Mathematics have an important influence on the students' performance in each subject, apart from acting as important mediator in the relation between learning style strategies and the students' achievements in the case of the Portuguese Language subject, but different results in Mathematics.

The common of this search is on finding that academic self-efficacy does not act, in the case of Mathematics, as important mediator in the relation between learning styles strategies and the students' achievements, which does not match with the obtained evidence from the investigation made to the Mathematics/Physics first year students in Guantanamo University.

Nevertheless, taking into consideration the mediator role of academic self-efficacy in the behavior of people, and the students' performance during the investigation, the authors assure that

the students' behavior and the results were a consequence of the low academic self-efficacy level in each of them.

Conclusions

The results of analyzing the significant differences between the average marks reached by the population of students in each learning style corroborated predominant trend of active style. Even though, after analyzing the planned contents, the described characteristics in literature for these subjects was not manifested as it supposed to be; for that reason the authors think on the existence of some elements that may regulate the manifestation of certain characteristics in each learning style, specifically, those in the Model of Kolb.

There was made a study of the level of academic self-efficacy in a population of students, finding that the results showed by Academic Self-Efficacy Scale revealed a low level of academic self-efficacy in each of them. These results affirm that academic self-efficacy helps to a successful learning process.

Starting by the results, there could be deduced academic self-efficacy play an important role in the manifestation of learning styles, especially in showing that lower levels of academic self-efficacy restrict the manifestation of style characteristics. Pointing out the small size of the studied population, the authors consider premature to arrive some conclusions about the level of academic self-efficacy role of a subject in the manifestation of learning style characteristics and the predominant trend.

However, the authors considered that the results, with some restrictions, lead new expectations of investigation related with these two variables, these variables have proved being an important step in the learning process.

Similar studies may reveal interconnections between learning style and academic self-efficacy, giving elements to support the development and organization of the teaching learning process and their own results.

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