

Impact of a didactic sequence on basic Astronomy concepts for graduates in Physics of online and classroom modalities

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INTRODUCTION

- Astronomy in the component of curricular Physics.
- A physics teacher will at some point approach to this science.
- PCN+ (Brasil, 2002), (Earth, Universe and Life) ↔ National Curricular Guidelines for Physics Courses (no recommendation).
- Research shows:

Works	Total of Courses Examined	Courses with Compulsory Subjects	Courses with Elective or Opticional
Bretones (1999)	70	12 (≈ 17 %)	10 (≈ 14 %)
Justiniano <i>et al.</i> (2014)	132	20 (≈ 15 %)	42 (≈ 32 %)

OBJECTIVES

- In order to broaden the discussion about teacher education in Physics, this paper aims to present:
 - 1) Results obtained by with the application of a questionnaire at the beginning (pre-test) and at the end (post-test) in a course for Physics graduates of a Distance-Learning-Course (DLC) and a Face-to-Face-Course through didactic sequences, called Potentially Significant Teaching Units - PSTU.
 - 2) The level of satisfaction of the students in relation to their respective course.

MATERIALS AND METHODS

- Research subjects: Licentiates in Physics of DLC - and Face-to-Face-modalities

Modalities / Occurrences	DLC	Face to face
Enrolled	47	13
Dropouts	9	3
Attended a course	38	10
Participated in the pre-test	23	13
Participated in the post-test	27	10
Participated in both tests	17	10

DLC: Two classes of the 3rd and 4th periods respectively. Face to Face: A class from the 3rd period.

MATERIALS AND METHODS

- **A study developed in four stages:**
 - 1) Application of a diagnostic questionnaire (pre-test) (Canalle, 2003), (Mourão, 1987).
 - 2) Conducting a course organized with Potentially Significant Teaching Units - PSTU.
 - 3) Replication of the questionnaire (post-test, after four months), and application of the satisfaction questionnaire.
 - 4) Realization of an hypothesis test to compare the means obtained before and after the course, as well as the analysis of the students' level of content in relation to the course.

PSTU - Potentially Significant Teaching Unit

- PSTU is a didactic sequence consisting of a teaching unit, where the proposed theme is structured through a succession of steps, which are based on learning theories, especially the theory of meaningful learning (Moreira, 2011).
- This construction follows eight steps.

PSTU - Potentially Significant Teaching Unit

- **Steps for its elaboration:**

- 1) Definition of the theme.
- 2) Externalizing the students' previous knowledge.
- 3) Presenting problematical situations, or previous organizers.
- 4) Presentation of the content, taking into account the progressive differentiation.
- 5) Expanding knowledge, seeking inclusive reconciliation.
- 6) Completing the unit, resuming the most relevant characteristics of the content.
- 7) Evaluation of learning.
- 8) Evaluation of the PSTU.

PSTU- Potentially Significant Teaching Unit

- **Defined Topics:**

- 1) Our Place in the Universe.
- 2) Celestial Sphere and Astral Daytime Movement.
- 3) Annual Movement of the Sun and Seasons of the Year.
- 4) Phases of the Moon and Eclipses.
- 5) Movement of the Planets.

FOURTH STAGE

- Thus, to compare the means obtained in the initial (pre-test) and final (post-test) stages, a student's t-test was used to compare the means of two paired samples.
- Parameters for the interpretation of results:

Stat t > 0	Formulation of hypotheses	$H_0: \bar{x}_i = \bar{x}_f$ e $H_1: \bar{x}_f > \bar{x}_i$
P(T<=t) = p	Descriptive level (p) $\alpha = 0,01$ (Significance level)	$p < \alpha \rightarrow$ reject H_0 $p \geq \alpha \rightarrow$ no reject H_0
Stat t and t critical	Test result: right-hand the one-tailed test	$t > t$ critical \rightarrow reject H_0 $t < t$ critical \rightarrow no reject H_0

RESULTS AND DISCUSSIONS

- Results obtained with the questionnaire (pre-test and post-test), considering the means of each respondent.

Modality DLC								Modality Face to Face			
Pre-Test				Post-Test				Pre-Test		Post-Test	
1	5,38	15	4,62	1	6,15	15	8,46	1	4,62	1	6,15
2	4,62	16	3,85	2	7,69	16	2,31	2	5,38	2	8,46
3	6,15	17	4,62	3	4,62	17	3,85	3	9,23	3	9,23
4	3,85	18	3,08	4	6,92	18	6,15	4	5,38	4	8,46
5	2,31	19	5,38	5	5,38	19	8,46	5	5,38	5	8,46
6	2,31	20	5,38	6	4,62	20	3,85	6	3,85	6	8,46
7	6,15	21	3,85	7	6,15	21	6,92	7	6,15	7	8,46
8	4,62	22	1,54	8	4,62	22	4,62	8	6,92	8	9,23
9	7,69	23	4,62	9	10,0	23	6,15	9	5,38	9	8,46
10	8,46			10	9,23	24	7,69	10	3,08	10	4,62
11	7,69			11	10,0	25	6,15	11	6,92		
12	5,38			12	9,23	26	7,69	12	9,23		
13	3,85			13	6,92	27	6,15	13	4,62		
14	3,85			14	7,69						10

Test t: Pre-test and Post-test comparison in DLC modality

		<i>Post-Test - DLC</i>	<i>Pre-Test - DLC</i>
1	Average	6,696470588	5,023529412
2	Variance	5,153586765	3,106749265
3	Observations	17	17
4	Pearson Correlation	0,587542239	
5	Hypothesis of average difference	0	
6	gl	16	
7	Stat t	3,656603984	
8	P(T<=t) the one-tailed test	0,001064406	
9	t critical the one-tailed test	2,583487185	
10	P(T<=t) the two-tailed test.	0,002128812	
11	t critical the two-tailed test	2,920781622	

T-test: two samples in pairs for means:

Stat t > t critical (3,656603984 > 2,583487185), thus rejecting H_0 at the 1% level of significance. Therefore, the second hypothesis where x_f (mean in the post-test) is greater than x_i (mean in the pre-test) will be accepted. The difference in means are statistically significant.

Test t: Pre-test and Post-test comparison in Face to Face modality

		<i>Post-Test – Face to Face</i>	<i>Pre-Test – Face to Face</i>
1	Average	7,999	5,537
2	Variance	2,126921111	2,861001111
3	Observations	10	10
4	Pearson Correlation	0,696432751	
5	Hypothesis of mean difference	0	
6	gl	9	
7	Stat t	6,249464595	
8	P(T<=t) the one-tailed test	0,000074865	
9	t critical the one-tailed test	2,821437925	
10	P(T<=t) the two-tailed test.	0,00014973	
11	t critical the two-tailed test.	3,249835542	

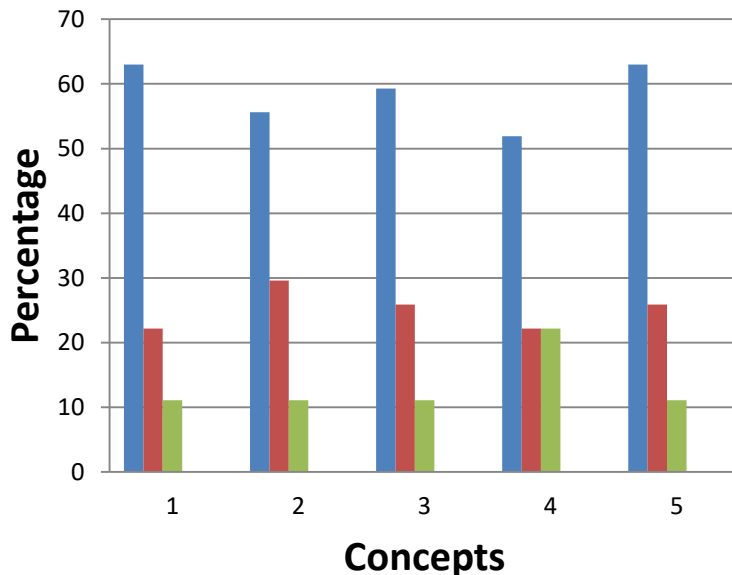
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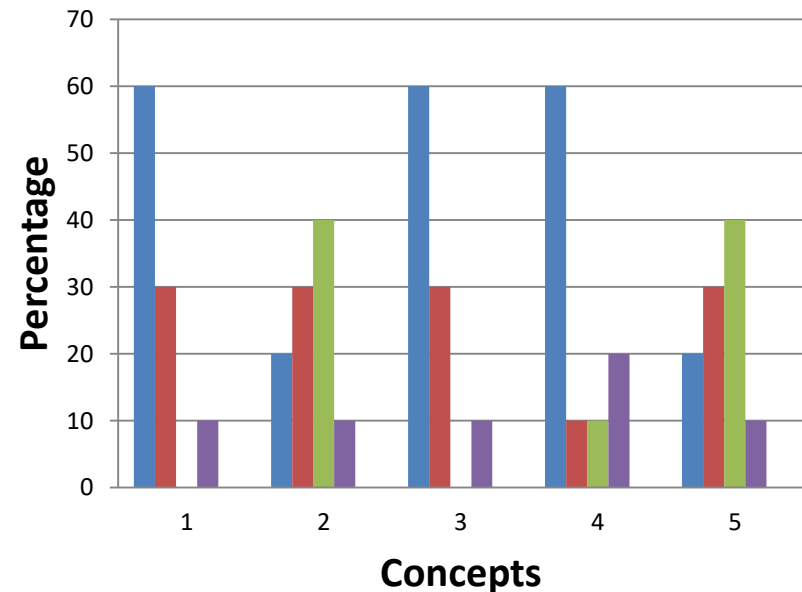
Satisfaction Questionnaire, 1st Aspect: Regarding didactic material

- In this case 5 concepts were presented, and the respondents could mark with a cross each of it: **Great**, **Very Good**, **Good**, **Satisfactory** or **Unsatisfactory**.

Satisfaction 1st Aspect - DLC



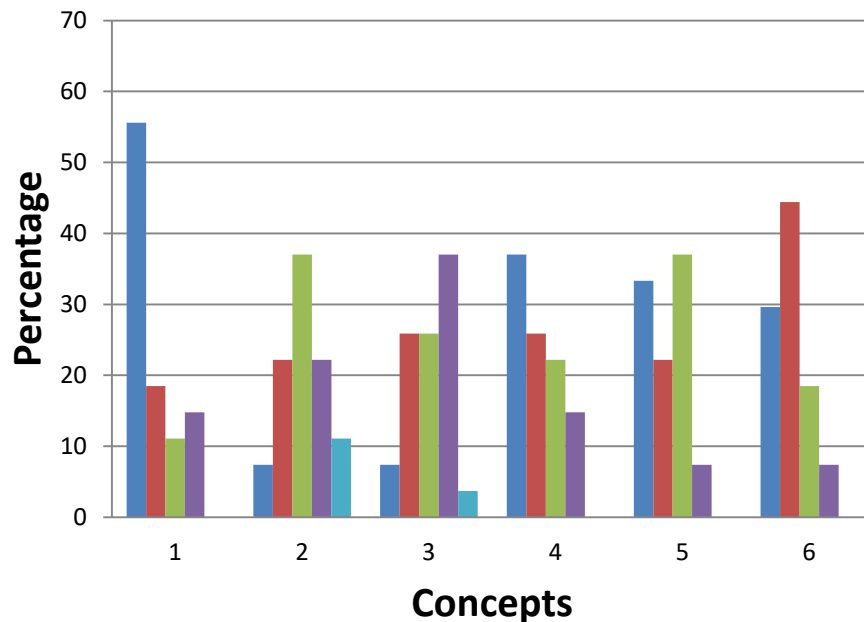
Satisfaction 1st Aspect – Face to Face



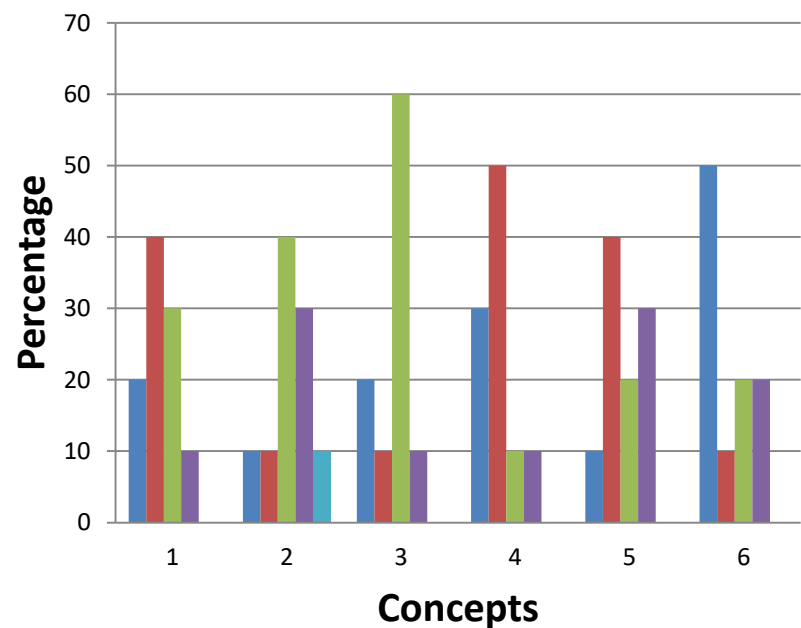
Satisfaction Questionnaire, 2nd Aspect: Regarding the developed activities and the possible evolution in the level of knowledge

- In this case, 6 concepts were presented, and the respondents could mark with a cross each of it: **Great**, **Very Good**, **Good**, **Satisfactory** or **Unsatisfactory**.

Satisfaction 2nd Aspect - DLC



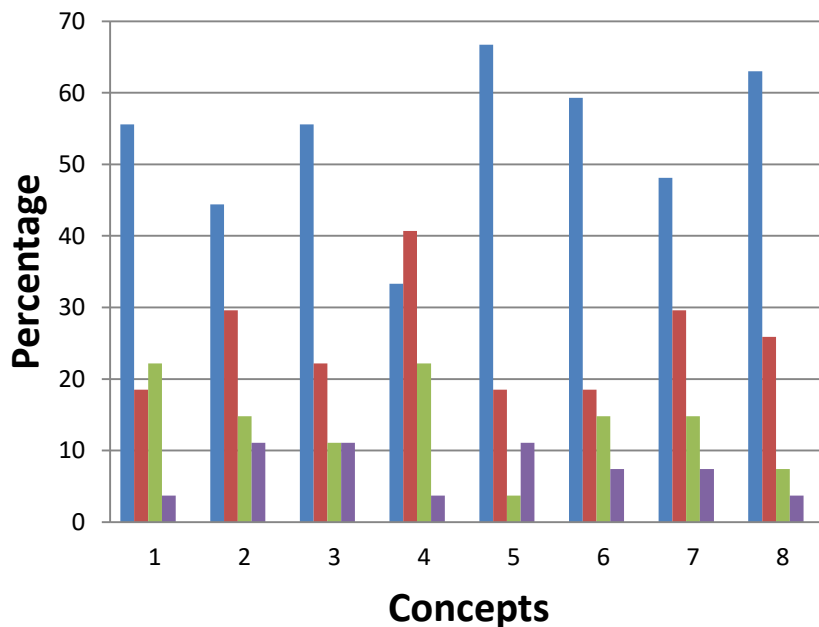
Satisfaction 2nd Aspect – Face to Face



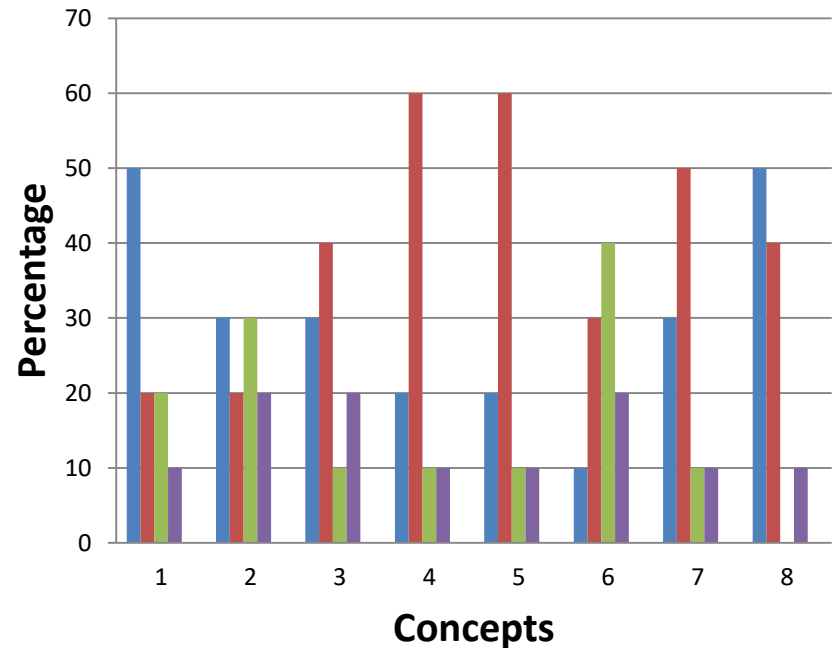
Satisfaction Questionnaire, 3rd Aspect: Regarding the evaluations and the benefit of the course.

- In this case, 8 concepts were presented, and the respondents could mark with a cross each of it: **Great**, **Very Good**, **Good**, **Satisfactory** or **Unsatisfactory**.

Satisfaction 3rd Aspect – DLC



Satisfaction 3rd Aspect – Face to Face



FINAL CONSIDERATIONS

- The results show that:
 - 1) This course has created a favorable learning climate, thus it contributes to the initial training of future physics teachers.
 - 2) Potentially Significant Teaching Units are promising didactic-pedagogical tools which can be used in this process.
 - 3) The course was successful in terms of the participants' level of satisfaction, since the concepts investigated in the satisfaction test were approved by most respondents such as: Good, Very Good or Great.

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