New methodological strategy for online teaching-learning with "Digital Capsules".

Lucía Santelices[1] and Caterina Tiscornia[2]*

[1] Escuela de Medicina, Universidad Finis Terrae; lsantelices@uft.cl, ORCID ID https://orcid.org/0000-0003-3295-4151

[2] Escuela de Nutrición y dietética, Universidad Finis Terrae[2]; ctiscornia@uft.cl, ORCID ID https://orcid.org/0000-0002-0138-083X

* E-mail address: ctiscornia@uft.cl

Abstract

Introduction: In the recent pandemic scenario, achieving learning outcomes for institutions of higher education in health sciences has become a great challenge. The forced shift from face-to-face to distance learning has generated the need to adapt the existing traditional pedagogical designs.

Objective: To describe an online teaching-learning methodological strategy that incorporates digital capsules and the level of satisfaction of students taking Basic Nutrition I of the Nutrition and Dietetics program during the year 2021.

Methods: Cross-sectional study of descriptive scope circumscribed under a mixed methodological design. The sample was purposive. The methodological design of the didactic strategy was based on the model of Pozo C. et al, Hepp P and Santelices L. et al. The digital capsules included digital animation. Descriptive statistics were used to analyze the results.

Results: An online methodological strategy for working in health sciences careers with two learning spaces is described and the steps that could be taken to implement it are described. 94% of the students positively perceived its incorporation as a useful resource for their learning.

Conclusions: The strategy works because students perceive that it facilitates their understanding, helps them retain information and apply it. However, it is necessary to review its structure because it does not favor the application of exercises involving mathematical procedures. The need arises to deepen experimental studies to gather more evidence.

Keywords: Teaching-learning strategy, online learning, digital capsules.

1. Introduction

In the recent pandemic scenario, achieving learning outcomes for institutions of higher education in health sciences has become a great challenge. The forced transition from face-to-face to distance learning (1) and the consequent implementation of online teaching (2) in all educational stages (3-4), has made it essential to work with new methodological teaching strategies, thus creating the need to adapt the existing traditional pedagogical designs. This change has posed enormous pedagogical, technological and competency challenges. However, it represents an important opportunity to propose more flexible learning possibilities, explore and combine teaching, learning and evaluation methodologies oriented to conduct synchronous and asynchronous curricular scenarios. As pointed out by Elliot Montero in 2021, with a flexible learning design that should enhance self-regulated learning activities (5-6).

In addition to the fact that teachers face daily students of a generation inserted in a total multimedia universe, which they do not frequently use for academic work (7), there is a need to realign them in the use of digital technologies for learning (8). This makes it imperative to propose

tools to take advantage of these resources in order to achieve the expected learning outcomes (9). This change of scenario has implied collecting evidence about technology and it is pointed out that it alone could not achieve effective learning in students (10). It is also indicated that organizing synchronous and asynchronous spaces requires designing a variety of activities and resources with different formats, audios, texts, videos, to avoid student fatigue and boredom (11). On the other hand, the design of contents and pedagogical strategies are necessary to take advantage of resources and modify teacher-centered practices and traditional teaching approached as a linear process (12).

Using digital capsules as learning resources implies for teachers to adapt to a telematic form of social interaction, stimulating in them three levels of increasing complexity: Searching, selecting and creating digital capsules; Analyzing how to convert into knowledge the information that these capsules carry and knowing how to communicate it to their students. Also, it is necessary to keep in mind that the use of digital capsules requires for synchronous spaces to plan activities that stimulate complex executive brain functions, which lead students to respond to problem-solving challenges (13). This is very relevant because recent studies indicate that the effect of the screens weakens the basic executive brain functions, such as: working memory, inhibitory control and cognitive flexibility (14). In view of the above, the following research problem arises: Currently, it is not clear ¿what are the characteristics that an online teaching-learning strategy that incorporates digital capsules should consider to facilitate learning and improve the level of satisfaction of students in health sciences careers? To answer this question, two objectives were proposed for the study: To determine how to design an online teaching-learning methodological strategy that incorporates digital capsules and to describe the level of satisfaction of students taking Basic Nutrition I of the Nutrition and Dietetics course during the year 2021.

2. Methods

The design was a cross-sectional study of descriptive scope and is circumscribed under a mixed methodological design (15). The sample selection followed a sequence of steps outlined below:

a) Total population of cases, segmented into 2 semesters. Year 1:
b) 66 students for the year 2021 in the second semester (Semester where the subject was taught), and course 2: 80 students. From these groups were discounted those who were not entering the first semester identified through the admission period, and all cases that correspond to exchange students (free students).
c) From these groups for the year 2021, a discount analysis of extreme outlayer cases was performed.
d) In the case of the year 2021, an outlayer discount analysis was also performed. In the following box-plot graph, the analysis of the outlayer case discounting is sought through a visual inspection, whereby case 1 is discounted, with average score 1.
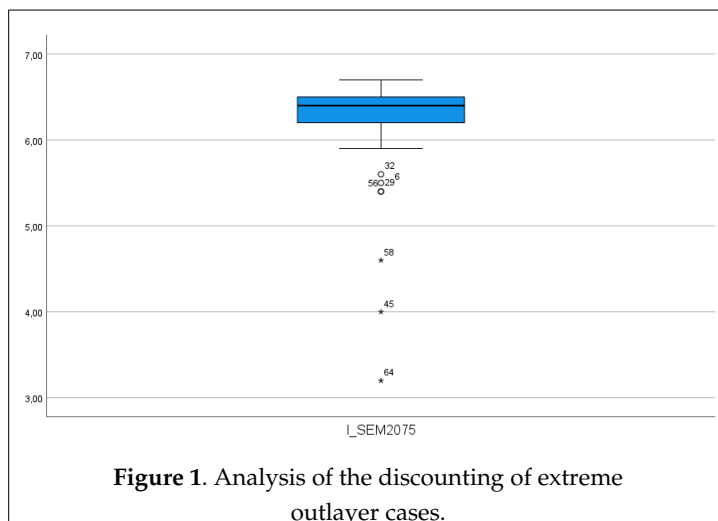e) Validated sample for analysis: a total of 77 cases from 2020 and 65 cases from the 2021 period.

Figure 1. Analysis of the discounting of extreme outlayer cases.

In the box-plot graph of figure 1, the analysis of the discount of outlayer cases is sought through a visual inspection, so cases 58, 45 and 64, with average grades 4.6, 4 and 3.2, were discounted. Figure 2 shows the discounted case explained in point d above.
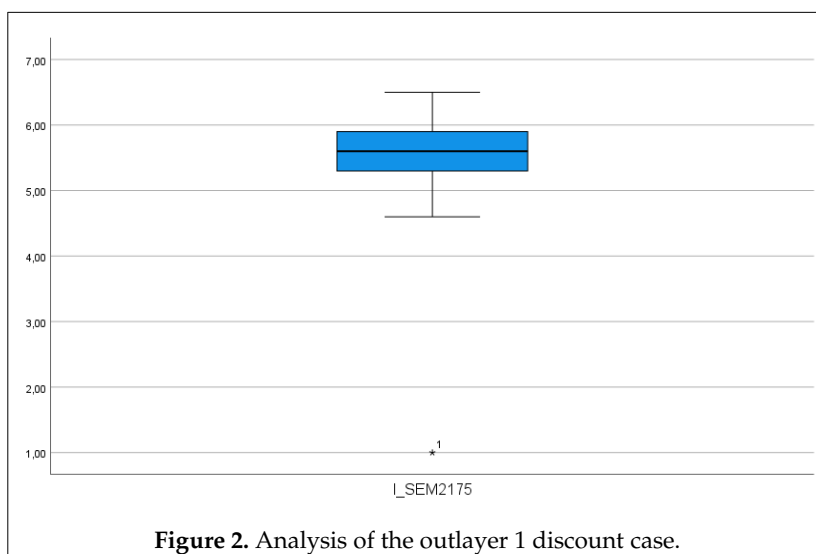

Figure 2. Analysis of the outlayer 1 discount case.

The analysis of the sample included a data validation process, considering the ideal structure to perform possible variance analysis. Finally, by means of Student's t test, it was determined that the 2020 and 2022 samples do not present significant differences.

A second step corresponded to the methodological design of the teaching strategy to implement the online proposal. This design was based on the model of Pozo, Hepp and Santelices (16, 17-18). These consider that knowledge must be transformed by the students, who from their own search for information, using technological resources, must understand them in depth, evaluate them and formulate new questions. This involves the active collaboration of teachers in this process (19).

Based on the above, in this project, digital capsules were designed, whose approach was considered to be part of the implementation of the asynchronous phase of the teaching-learning strategy (EEA). These capsules were materialized in videos of a maximum of 15 minutes. In them, digital animation was mixed with face-to-face recordings of the teacher, in order to bring the content of the unit to various forms of presentation, visual, written and auditory. These digital capsules contain explanatory animations, concept maps, diagrams, drawings and other elements that allowed the teacher to better explain the specific contents addressed in the five selected learning units. Table 1 shows the units and learning outcomes in which a digital capsule was incorporated.

Table 1. Units and learning outcomes in which a digital capsule is incorporated.

Learning unit	Specific learning outcomes of the unit
Energy metabolism and energy requirements.	✓ Defines theoretical concepts of nutrition. ✓ Describes the components of energy metabolism and macronutrients.
Proteins and nutritional recommendations.	✓ Defines metabolism and specific functions of proteins in the body. ✓ Assesses protein intake and calculates protein recommendations in the healthy population. ✓ Founds dietary modifications to satisfy protein requirements in healthy individuals.
Lipids and nutritional recommendations.	✓ Defines metabolism and specific functions of lipids in the body. ✓ Assesses intake and calculates lipid recommendations in healthy population. ✓ Provides a rationale for dietary modifications to meet lipid

	requirements in healthy individuals.
Carbohydrates and nutritional recommendations.	✓ Defines metabolism and specific functions of carbohydrates in the body. ✓ Assesses carbohydrate intake and calculates carbohydrate recommendations in the healthy population. ✓ Provides a rationale for dietary modifications to meet carbohydrate requirements in healthy individuals.

The elaboration of the digital capsules required previous basic knowledge in the audiovisual area and management of the digital platform in which the material was shared. For this exercise, the following programs were used: Adobe After Effects for assembly and animation, Adobe Illustrator for digitalization of illustrations, Adobe Photoshop for photographic retouching and Audacity for audio recording and editing.

Data collection instrument.

To collect the students' perceptions, an instrument had to be designed and validated which is attached in Annex 1 (supplementary material). The instrument considered two dimensions about the strategy applied to conduct learning: the teaching methodology and the development of thinking skills it stimulated in the students. Both dimensions with their corresponding sub-dimensions and criteria were organized in a Likert-type scale of three sections. The instrument was validated using the Delphi method (20). The Delphi method is a tool for gathering information from a group of experts, reaching a consensus and establishing priorities that would be useful for making decisions on specific issues. The first version of the questionnaire was sent to the experts with a 15-day response deadline. The responses were analyzed by the researchers to establish consensus and recognize the questions where there was no agreement among them. The latter were eliminated. Subsequently, the questionnaire was sent back to the same judges to make sure that the adjustment suggested by them was respected in the reedition and finally, the final questionnaire was constructed.

Analysis of results.

The analysis of the information regarding the qualitative aspects of the questionnaire was carried out using central tendency statistics, which made it possible to gather the students' perceptions.

Application of the didactic strategy.

The didactic strategy was applied during one semester. At the end of the course, the instrument designed to evaluate students' perceptions was applied. The results are described below.

Perceptions of students in Basic Nutrition I 2020 course, and perceptions in Basic Nutrition I 2021 course.

The questionnaire was applied to a total of 52 students at the end of their first semester academic period. The study had the acceptance of the Ethics Committee of the Faculty of Medicine. All participating students were informed, expressed their agreement to participate and signed their consent.

3. Results

The methodological design of the teaching-learning strategy considered as an organizing axis the three moments that make up a class: a brief initial space, which includes the construction of the intentionality of the class, followed by the development and closure. In the initial space, the teacher declares the learning that he/she expects the students to achieve in the class and shares the sequence of milestones that they will work on. The initial interaction concludes with a challenge proposed by the teacher. It can be an open-ended question or another learning resource whose objective is to activate the neural circuits that will make the student's learning meaningful. In this

space, students connect their knowledge with the demands of the challenge or initial question, which is also called a generative topic because it activates the neural circuits associated with the knowledge that will be discussed in class. This is what activates their previous knowledge and makes the new knowledge meaningful.

Afterwards, the development of the synchronous class began. This space is intended to be a space for student-centered work and exchange. It used to start by collecting the students' ideas regarding the initial generating topic, followed by a brief presentation by the teacher that allowed the students to articulate their knowledge with the new ideas contributed. This was followed by activities to solve real problems typical of the professional field in the clinical reality and synthesis of new knowledge developed by the students to deepen their understanding of the new subject.

Subsequently, a closing activity is worked on. This is an activity that allows students to make a personal synthesis of their learning. It is an activity that forces them to recapitulate what they have learned, to make sense of it, and leads them to connect with their personal work in the asynchronous space. The closing is a student activity that could end with the sharing and gives the opportunity to formatively evaluate the learning results achieved (see table 2).

Table 2. Description of moments of the synchronous space.

Stages	Activity developed by the teacher
Construction of intentionality	Each class begins by pointing out expected learning.
	Subsequently, the main activities that the students will carry out in the class are indicated (objectives/expected learning outcomes and what core activities they will develop to achieve them).
	Then a generative topic is proposed, which gives way to the development of the class.
	It should be noted that it is related to the digital capsule seen in the asynchronous space of the previous session.
Classroom development	The students' results regarding the generative topic are collected.
	The contents of the class are addressed, considering a logical sequence and providing clear ideas.
	During the development of the class, the integration of the contents addressed in the asynchronous class of the previous week is considered.
	In it, students perform individual or cooperative activities that are articulated with question and answer spaces that allow clarifying doubts, giving examples, rectifying misunderstood concepts and completing with some missing ones.
	Relevant examples are proposed.
	Activities such as outlines, summaries, or other activities are carried out so that the student integrates the new knowledge into his or her outlines.
	During the class there are rounds of questions answering the students' questions.
Closing of the class	A workspace is generated for shared synthesis.
	The synchronous class culminates with a metacognition activity, which asks the student to point out the learning achieved and those to be achieved.

For the Asynchronous stage of the class, a schedule was given indicating the sequence of personal work consisting of: readings, design of concept maps, observation of a digital capsule and resolution of an application problem (see Table 3).

Table 3. Description of asynchronous space moments.

Stages	Activity developed by the teacher
Sequence of instruction delivery	A chronogram is provided with the sequence to develop the activities.
	They are asked to read complementary material, which provides information according to the contents addressed in the following synchronous class. They are asked to synthesize information. They are instructed to visualize the digital capsule, which prepares the student for the next synchronous class.
Applied student work	The student performs problem solving activities autonomously.

Results of perception about the methodological strategy with digital capsules expressed by 52 students of the Basic Nutrition 1/2021 course.

The results indicate that 94% of the students perceive positively the incorporation of digital capsules as a useful resource for their learning because the previous work done with the digital capsules was necessary to solve problems during their synchronous classes. 90% indicated that when they used the digital capsules in their asynchronous spaces, they remembered the contents more easily and could apply them in the activities carried out in the face-to-face, synchronous classes. In the open comments, it was possible to detect that they found difficulty in doing the mathematical calculations that were demonstrated in the digital capsules and did not facilitate the resolution of problems addressed during the synchronous classes. A total of 71% recognize that the digital capsules were useful to memorize the contents. A 63% of the students indicated that the capsules favored the elaboration of autonomous works, some indicated that "the capsules were always very complete and always contained exercises which were solved in the same video". However, others indicated that "the capsules were good to introduce the subject explained in classes, but it could be explained more precisely how to approach the exercises of application of the subjects". Table 4 shows a summary of the qualitative results obtained from the analysis of the students' discourse.

Table 4. Perceptions of cohort 2021 students about the usefulness of digital capsules.

Question	Answer	n	%
The problem-solving activities in the synchronous classes required the work done before the sessions (viewing the digital capsule and reading supplementary documentation).	Strongly Agree	26	50
	Moderate agreement	23	44,2
	Strongly disagree	3	5,7
The contents worked on independently, using digital capsules, were easily remembered and applied in synchronous classes.	Strongly Agree	29	55,7
	Moderate agreement	19	36,5
	Strongly disagree	4	7,6
I thought the digital capsules were nice and I was satisfied with their contribution to memorize the subjects more easily.	Strongly Agree	37	71,1
	Moderate agreement	13	25
	Strongly disagree	2	3,8
I found the time invested in observing the capsules to be beneficial to my learning.	Strongly Agree	35	67,3
	Moderate agreement	14	26,9
	Strongly disagree	3	5,7

Table 5. Students' perceptions about the usefulness of capsules to facilitate the execution of exercises.

Question	Answer	n	%
The digital capsules helped me to perform the exercises and independent work.	Strongly Agree	33	63,4
	Moderate agreement	13	25
	Strongly disagree	6	11,5

The exercises at home, using the digital capsules, prepared me theoretically to tackle clinical reasoning tasks during the synchronous classes.	Strongly Agree	28	53,8
	Moderate agreement	16	30,7
	Strongly disagree	8	15,3

Table 6. Free comments about the use of digital capsules.

"I personally felt that I learned in a better way through the capsules than with 2 hours of class, the capsules were always very complete and always contained exercises which were solved in the same video, I sincerely appreciate the work of the teachers and I hope that in NBII there are also this type of resources since it supports me a lot at the time of study."
The capsules were very nice, it was a pleasure to look at them and it was also complemented with the classes and it was great.
They were very helpful.
I liked the way the subject was approached, since the material was shown in a summarized, introductory way, and for the next class we came prepared with what we had seen in the capsule, I also liked the format, it looked nice and captured the attention.
The capsules were good for introducing the subject matter explained in class, but the application of exercises could be explained more.
It is appreciated that the capsule time did not exceed 15 minutes, as this makes the time spent looking at the capsule much more efficient.
The capsules did help me in my learning, however, there was a lack of emphasis for the problems that required calculations to be done to understand them better.

4. Discussion

The study was positive and, considering the limitations of a basic descriptive study, it is necessary to make some points that deserve attention.

The discourses that indicate the acceptance and usefulness for learning, declared by a high percentage of students, would indicate that the digital capsules are useful to facilitate their learning. In this study we worked with a strict protocol whose basis was active learning and given that the literature shows that the efficiency and effectiveness of the methodology that stimulates active learning improves the results by 60% (21), there is a need to investigate more about the variables related to student learning, using digital capsules in asynchronous workspaces.

The academic work carried out in the asynchronous space of the class, in which the students 2021 assume total protagonism using digital capsules to learn was well valued. They apply to problem solving in the synchronous space of the class, what they have learned with the presentation of relevant content through digital capsules in the asynchronous workspace of each class. However, although the digital capsules support the comprehension and memorization of contents and are very well valued by the students, it is necessary to investigate further because the results are preliminary. This would imply working with new teaching competencies because current evidence suggests that using digital capsules as learning resources requires teachers to adapt to a telematic form of social interaction that combines three levels of increasing complexity: searching for, selecting and creating digital capsules; analyzing how to convert the information that these capsules carry into understandable knowledge for a student; and figuring out how to communicate it to their students (22). Perhaps it would be important to delve deeper into these issues.

It is suggestive of the extent to which students express in their "free" comments in the questionnaire applied. Some students point out that with the capsules they were not able to learn

the mathematical procedure involved. Perhaps it would be necessary to incorporate digital capsules whose objective is to present step by step how the mathematical algorithms involved in the capsules are solved. This could support learning associated with mathematical calculations that could be a limiting factor in solving problems. In relation to this, we suggest in future research to deepen in this line with an experimental study, where classes are fully incorporated in online modality, involving specific synchronous and asynchronous spaces; and digital capsules that allow facilitating learning through its use in health sciences careers, strengthening the independent study of students. It should be noted that although our study has the limitation of being descriptive, it allows us to describe, for the first time, an online methodological strategy for working in health sciences careers with two learning spaces and shows the steps that could be taken to implement it. However, our results cannot be extrapolated to other non-health careers.

In conclusion, the use of digital capsules inserted in an EEA that involves synchronous and asynchronous phases is favorable, since it allows incorporating a new teaching-learning resource, adapted to current times, where the modernization of tools and use of digital platforms is sought, being a contribution not only for academics, but also for students, who learn in a closer and more didactic way. Therefore, based on the results obtained, we recommend that educators or institutions interested in innovation and incorporation of this tool, consider including them in several units of the study programs, considering identifying the most relevant topics and making a design using digital programs that allow visualizing and listening to the contents in a clear way.

5. Conclusions

- The use of digital capsules inserted in an FSS that involves synchronous and asynchronous phases is favorable, since it allows incorporating a new teaching-learning resource, adapted to current times, where the modernization of tools and use of digital platforms is sought, being a contribution not only for academics, but also for students, who learn in a closer and more didactic way.
- The strategy works because students perceive that it facilitates their understanding, helps them retain information and apply it. However, it is necessary to review its structure because it does not favor the application of exercises involving mathematical procedures.
- We recommend that educators or institutions interested in innovation and incorporation of this tool, consider including them in several units of the study programs, considering identifying the most relevant topics and making a design using digital programs that allow visualizing and listening to the contents in a clear way.
- There is a need to deepen experimental studies to gather more evidence.

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Annex 1

Teaching-learning and evaluation methodology with the incorporation of digital capsules.

The purpose of this test is to collect your feedback on the methodology used in this course. **Please mark with an X one of the three options in each indicator.**
1: Strongly Disagree
2: Moderate agreement
3: Strongly Agree

Dimension	Sub. Dimension	Criteria / Indicators	1	2	3
Methodology	Teacher guidance	Learning climate 1. The teacher at the beginning of each synchronous session made it clear to me what I was expected to learn in each class.			
		2. The challenges and questions posed by the teacher in each synchronous class were interesting to me because I could answer them since I had previously worked with digital classrooms.			
		3. I was satisfied with the overall methodology of the course.			
		4. I found the class more agile when the teacher asked us to solve a problem and gave clear instructions to apply what was known through the capsules.			
Development of thinking skills	Synchronous space activities	Application of knowledge 5. After working at home, I could apply the contents of the digital capsules during the classes.			
		6. The activities during the development of the synchronic class allowed me to establish relationships between important concepts and ideas of the subjects worked on.			
		7. The exercises done at the end of each synchronous class seemed important to me to strengthen my learning.			
	Asynchronous space activities	8. For the problem-solving activities in the synchronous classes, the work done before the sessions (visualization of the digital capsule and reading of complementary documentation) was necessary.			
		9. The contents worked on independently, using digital capsules, were easily remembered and applied in synchronous classes.			
		10. The digital capsules helped me to better understand the subjects worked on in the synchronous sessions.			

	Digital Capsules	Assessment of the capsules for better learning. 11. I found the capsules interesting to learn better.			
		12. I found the time invested in observing the capsules to be beneficial to my learning.			
		13. I thought the digital capsules were nice and I was satisfied with their contribution to memorize the subjects more easily.			
	Self – Employment	Valuation of self-employment 14. The capsules helped me to organize my study activities during the independent work.			
		15. The digital capsules helped me to perform the exercises and independent work.			
		16. The exercises at home, using the digital capsules, prepared me theoretically to approach clinical reasoning tasks during the synchronous classes.			
		17. I feel that I learned better with this methodology that incorporates digital capsules.			

Comments:

You may add a comment if you wish.

THANK YOU VERY MUCH FOR YOUR CONTRIBUTION THAT WILL HELP US TO IMPROVE.