



Tuberculosis: Interdisciplinary View and Representation Using Artificial Intelligence

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Objective: Analyze the selection of concepts associated with Tuberculosis with an interdisciplinary approach by students from four Medical Sciences programs at a privately managed university in the city of Mar del Plata in 2023.

Materials and Methods: Descriptive, longitudinal research. Sample of 198 students of Medicine Research methodology, Bachelor's Degree in Nutrition, Kinesiology and Physiatry and Speech Therapy.

Results: The activity takes place in 4 phases, each lasting one week and is carried out asynchrony using documents shared online, monitored by the teaching team. In Phase 1, the Bulletin on Tuberculosis in Argentina is presented. All students are divided into 8 groups with members from the 4 majors. Each of them must propose three concepts associated with tuberculosis from their respective disciplines, which cannot be repeated with those selected by their classmates. In the second week, each person chooses one of the three concepts they selected the previous week and places it in a new grid in column A next to your name. In column B you must justify in 30 words why the concept you chose and placed in column A is associated with tuberculosis. In the third column you will indicate the concept of your group and what career the classmate who proposed it is from,

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pointing with the corresponding color. In the third week, they are presented with a diagram, called a spider web. (Minnaard,2019). In this case, the diagram presents 8 well-defined areas. Four of which correspond to each discipline indicated with preset colors: Speech Therapy, Medicine, Kinesiology, Nutrition. The concept of Tuberculosis is located centrally in the spider web located after the grid. An important aspect, the concepts that are considered most significant should be close to the center and the least significant ones further away. Exchanges between students from different majors must be recorded in this file indicating the name and surname of the person who proposes the concept or agrees with another participant, below the spider web diagram, for example, or if I decide to move it to the intermediate area. It is established that the minimum number of concepts to pass this activity is 20 and the maximum is 30. In the last week, students carefully observe in the spider web the concepts that were selected by students from two or more majors. They select two and create a prompt with them and the concept of tuberculosis using some Artificial Intelligence (AI) chat. The length should not exceed 20 words. Analyze the results of your classmates and together select the most relevant one. Based on this, they develop a research problem contemplating the aspects that are always considered. Place the result in the second box. That question is transformed into a statement and placed in the AI chat requesting to make an image inspired by the styles of famous abstract and cubist painters.

Conclusions: The implementation of strategies that encourage creativity and reflective thinking has been and is a challenge for higher-level teachers.

Keywords: Tuberculosis; strategies; creativity; interdisciplinary.

1. INTRODUCTION

From the teaching teams in charge of different higher level professors, a series of academic challenges have been presented that demand creativity and plasticity to be able to achieve the future that is envisioned. Artificial Intelligence AI in 2023 knocked on the doors of the classrooms. The advances in technology have been accompanying medicine. Artificial Intelligence has many potentialities concerning diagnosis among some of its strengths. [1] The historical

journey of Artificial Intelligence over time, allows to analyze the difficulties identified in each epoch and how they have been overcome [2]. The importance of technology in people's lives is highlighted, and they evolve day by day, although their future consequences are not known [3].

2. DEVELOPMENT

The stimuli captured by the senses pass through perceptual filters and this generates that at the

Phase 1	Phase 2	Phase 3	Phase 4
<p>The Bulletin on Tuberculosis in Argentina is presented.</p> <p>Each member of the eight groups must propose three concepts associated with tuberculosis from their respective disciplines</p>	<p>A table is presented where each student chooses one of the three concepts they selected the previous week and places it on the grid in column A next to your name. In column B, you must justify in 30 words why the concept you choose and place in column A is associated with tuberculosis. In the third column, indicate the concept proposed by another student in the work group, indicating what major the classmate is from.</p> <p>He proposed it, pointing with the corresponding color.</p>	<p>They are presented with a diagram, called a spider web. (Minnaard,2019). In this case, the diagram presents 8 well-defined areas. Four of which correspond to each discipline indicated with preset colors: Speech Therapy, Medicine, Kinesiology, Nutrition.</p>	<p>Students should look carefully in the spider's web at the concepts that were selected by students from two or more majors. Each student selects two and creates a prompt with them and the concept of tuberculosis using an Artificial Intelligence (AI) chat. The length should not exceed 20 words and must include the result in the table where your last name appears.</p>

brain level the coding is individual. Hence the richness that different perspectives bring to the analysis of a reality that is interesting to study [4]. In addition to this, the different faculties need to prepare future professionals to work with other disciplines [5]. The activity takes place in 4 phases, each lasting one week and is carried out asynchrony using documents shared online, monitored by the teaching team. All students are divided into 8 groups with members from the 4 majors. Each of them must propose three concepts associated with

tuberculosis from their respective disciplines, which cannot be repeated with those selected by their classmates. In this article they only present as an example the product made by group number 8 made up of five medical students, six nutrition students, nine Kinesiology and Physiatry students and three Speech Therapy students. Fig. 1 shows the activities that are developed in each of the four phases of the proposal.

3. PHASE 1 1st week

	Student	A	B	C
Medicine	E 1	Social determinants	Molecular diagnosis	Interministerial strategies
	E 2	Intersectoral strategies	Tuberculosis cases	Tuberculosis deaths Respiratory symptoms HIV
	E 3	Respiratory symptoms	Tuberculin test	HIV
	E 4	Health equipment	Diagnostic network	Communicable diseases
	E 5	Treatment scheme	Dispersible medication	Healthcare portfolio
Nutrition	E 6	Nutritional risk	Nutritional requirements	Eating habits
	E 7	Nutritional supplementation	Impact of alcohol consumption	Anthropometric parameters
	E 8	Foods to avoid	Weight loss	Effects of antibiotic treatment
	E 9	Degree of severity	Poor eating behavior	Assimilation and absorption
	E 10	Symptoms	Diabetes	Epidemiology
	E 11	Nutritional status	Micronutrient deficiencies	Poor nutrient absorption
Kinesiología	E 12	Lung expansion	Reeducation on exertion	Assisted and effective cough techniques
	E 13	Respiratory physiotherapy	Postural drainage	Respiratory functional re-education
	E 13	Fluidize secretions	bronchial Avoid intubation of the patient	Exercises to develop a semi-upright position
	E 14	Monoarticular tuberculosis	Infections Bones	Histopathological study
	E 15	Contrast baths	Diaphragmatic breathing	Percussion and thoracic vibration
	E 16	Strengthening respiratory muscles.	the Eliminate secretions..	Improve gas exchange.
	E 17	Improve respiratory capacity	Infection control	Pott's disease

	Student	A	B	C
	E 18	Cavernous murmur	Reeducate diaphragm functionality	Infectious disease
	E 19	Bronchial hygiene	Crackles auscultation	on Respiratory physiotherapy
Speech Therapy	E 20	Diet treatment	Dysphagia	Correct breathing
	E 21	Complications in communication	Odynophagia	Respiratory difficulties
	E 22	Voice characteristics	Breathing pattern	Dysphonia

4. PHASE 2 2nd week

Next, a path begins with the intention of working and beginning to think in an interdisciplinary way [6]. Each student chooses one of the three concepts/constructs that they selected the previous week and places it on the grid in column A next to the name. In column B, the student must justify in approximately 30 words why they are associated with tuberculosis. In Column C indicates that concept/construct selected by another classmate, which sparked their interest,

indicating it with the corresponding color. In the case of E1, the student is from Medicine and Assimilation and absorption was proposed by a student from the Bachelor's Degree in Nutrition and is highlighted in light blue. To select the length of approximately 30 words, the researchers based themselves on what was stated on the official website of the Argentine Republic, which states that for a sentence between 15 to 20 words are suggested and in the case of a paragraph, 40 to 70 words [7].

5. NUTRITION KINESIOLOGY MEDICINE SPEECH THERAPY

Career	Student	Chosen concept	Why is it associated with tuberculosis ?	Concept that surprised you
Medicine	E 1	Determinantes sociales	Social determinants generate inequalities in people's health and quality of life, which predisposes them to getting sick.	Assimilation and absorption.
	E 2	Intersectoral strategies	For the correct approach to TB, an articulation of the three systems, health sectors, is necessary	Pott's disease
	E 3	HIV	The risk of contracting it is greater in people infected with HIV.	Nutritional risk
	E 4	Communicable diseases	TB is within this group of diseases, because its causative agent is a bacteria that can be transmitted between people through the air.	Respiratory functional reeducation
	E 5	Health portfolio	Tuberculosis is a highly permanent disease in Argentina, especially in the most vulnerable sectors of the population, which is why it is necessary to have an updated national health portfolio on its diagnosis and treatment methods.	Side effects of antibiotic treatment

Career	Student	Chosen concept	Why is it associated with tuberculosis ?	Concept that surprised you
Nutrition	E 6	Nutritional risk	A high percentage of patients with tuberculosis are in a situation of poverty, lack of accessibility to food, health services, alcoholism, smoking, added to an increase in requirements and malabsorption, which affect their nutritional status, putting them at risk.	Food treatment
	E 7	Impact of alcohol consumption	Alcohol consumption causes poor adherence to anti-tuberculosis treatment	Strengthening the respiratory muscles
	E 8	Weightloss	Tuberculosis usually goes hand in hand with malabsorption, an increase in metabolic demands and a decrease in intake (one of the causes is abdominal pain due to antibiotic treatment), which will lead to an energy deficit that will cause loss of energy. patient's weight	Dysphagia
	E 9	Assimilation and absorption	This concept is associated with tuberculosis because the pathogen responsible for contracting tuberculosis multiplies within the cells of the immune system. taking advantage of cells' nutrients for their own growth and survival	.Strengthening respiratory muscles
	E 10	Diabetes	Diabetes is increasingly recognized as a risk factor for tuberculosis, and the two often coexist and affect each other.	Poor nutrient absorption
	E 11	Poor nutrient absorption	Nutrient absorption may be altered due to the quantity and/or quality of food consumed, and may also be due to drug resistance.	HIV
Kinesiology	E 12	Reduction in effort	The main objective is to reduce physical effort to help the patient recover properly without putting their health at risk.	Difficulty of understanding and expression
	E 13	Respiratory physiotherapy	Respiratory physiotherapy is a treatment technique widely used in patients with tuberculosis, since bronchial hygiene is important for recovery from the disease.	Death from tuberculosis

Career	Student	Chosen concept	Why is it associated with tuberculosis ?	Concept that surprised you
	E 13	Fluidize bronchial secretions	Treatments in the subacute stage seek to hydrate the secretions in order to mobilize them and eliminate them from the body.	Respiratory pattern
	E 14	Histopathological study	Through histopathological studies, the presence of acid-alcohol-resistant bacilli (AFB) can be confirmed among these bacteria, which causes tuberculosis.	Cavernous murmur
	E 15	Diaphragmatic breathing	It is used to re-educate breathing and try to normalize it,	HIV
	E 16	Strengthening the respiratory muscles	This is a set of exercises performed to improve the ability of the respiratory muscles to inhale and exhale. Helps improve breathing and lung capacity	Epidemiology
	E 17	Pott's disease	Potassium disease, also called vertebral tuberculosis, is a type of extrapulmonary tuberculosis that affects the spinal column.	Nutritional supplementation
	E 18	Functional reeducation of the diaphragm	Respiratory biomechanics is usually lost as a result of thoracic expansion, in this way the coordination of the respiratory muscles, in this case the diaphragm, is lost and along with this the strength of said muscle.	Respiratory pattern
	E 19	Respiratory Physiotherapy	Respiratory Physiotherapy is one of the treatment techniques that we have to implement in patients with tuberculosis, since bronchial hygiene is key to recovery from the disease, being a very effective therapy for the control and recovery of patients, without having effects. adverse.	Tuberculin test
Speech Therapy	E 20	Food treatment	Dietary treatment is very important since the patient with tuberculosis generally suffers from malnutrition due to increased metabolic demands and decreased intake. Due to this, treatment must be done to recover the lost weight.	Contrast bath

Career	Student	Chosen concept	Why is it associated with tuberculosis ?	Concept that surprised you
	E 21	Complications in communication	Patients who suffer from this bacterial disease have a chronic cough and difficulty breathing, which can affect communication. In this case, the speech therapist plays a rehabilitative role, performing breathing techniques and exercises to strengthen the vocal muscles; In turn, he can also carry out different communication strategies, such as the use of voice amplification devices or implementation of non-verbal communication techniques.	Impact of consumption alcohol
	E 22	Breathing pattern	Tuberculosis causes changes in the lung. generating imbalance in breathing.	Diabetes

6. PHASE 3 3rd week

Students are presented with a diagram, called a spider web [6]. This diagram has been specially designed in a shared document, with a format that allows it to be edited by the participants in the experience, as many times as they consider asynchronously. This makes the activity very dynamic, as the teacher can monitor the changes in the diagram during each of the days of the

third week. In this case, the diagram presents 8 well-defined areas, given that there are four careers involved. The four areas correspond to each discipline, indicated with pre-established colors: Phonoaudiology, Medicine, Kinesiology, Nutrition. The interspersed sections are used when a participant identifies a concept/construct that could also be addressed by a professional from his/her discipline.

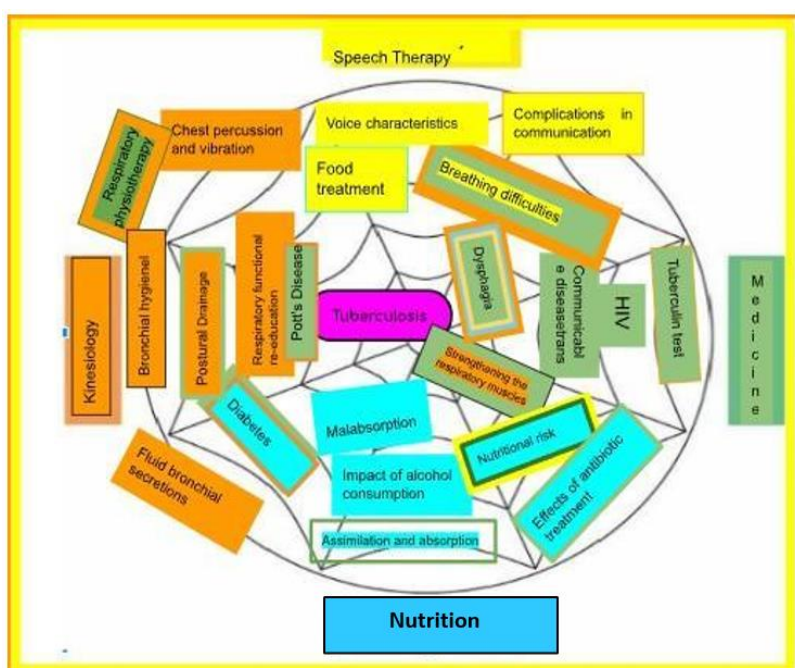


Fig. 1. Activities develop in each phases

Returning to the topic of interest, in this case Tuberculosis, this term would be located centrally in the spider web located after the grid. An important aspect, the concepts that are considered most significant should be close to the center and the least significant ones further away. Exchanges between students from different majors must be recorded in this file indicating the name and surname of the person who proposes the concept or agrees with another participant, below the spider web diagram, for example, or if I decide to move it to the intermediate area. For example Breathing difficulties was proposed by a Speech Therapy student, later other students recognised that it

could also be approached from Medicine and Kinesiology. The author refers to the following as one of the objectives of interdisciplinarity: "To promote the integration of particular sciences (disciplines) in the solution of real problems" [8]. But the passage from disciplinarity to interdisciplinarity is not automatic; it is necessary for pupils to go through stages or, as they are called here, phases. In this third phase, this transition begins to be perceived and is continued in phase 4.

In addition, each student is asked to justify their participation in the elaboration of the activity.

Career	Student	Indicate your participation in the spider web
Medicine	E 1	I chose "Pott's Disease" as an interdisciplinary concept between Kinesiology and Medicine, painting the picture in green and its edges in orange. On the other hand, I selected "nutritional risk" as a concept that is mainly addressed by Nutritionists (turquoise box), but that can also be treated by Medicine (green borders).
	E 2	Place the concept of "nutritional risk" as interdisciplinary between Medicine and Nutrition, painting the box light blue and its edges green. Also select "communicable disease" in the Medicine area in green.
	E 3	I added the concepts "HIV" and "dysphagia." I placed "HIV" in the area of medicine and "dysphagia" I considered interdisciplinary along with speech therapy, so I boxed it in yellow and placed it between both disciplines. I eliminated the concept "dysphagia" that was in orange and added the border to the concept that I had previously written, since it was later repeated by a colleague. I added the green Medicine box to the "Diabetes" concept. I added the orange Kinesiology box to the "Respiratory Difficulties" concept. I also added the yellow box for Speech Therapy to "nutritional risk."
	E 4	I added the concept of "repercussion of alcohol consumption" between the disciplines of Medicine and Nutrition, so it contains both colors; and the concept of "tuberculin test" which seems exclusive to medicine to me.
	E 5	Add the concept "strengthening the respiratory muscles" in the Kinesiology discipline, I consider it interdisciplinary with medicine so I added it in orange with a green box. It also added "respiratory difficulties" interdisciplinary between medicine and speech therapy, so I placed it between both, in yellow and with a green box.
Nutrition	E 6	I selected the concept of "dysphagia", from speech therapy, and placed it close to the Nutrition degree as well; since a complication in swallowing would further aggravate the nutritional situation.
	E 7	I chose "feeding treatment" from speech therapy. It covers nutrition from different disciplines in order to improve and maintain the nutritional status that is affected by concomitant effects of the disease.
	E 8	I chose "Dysphagia," a concept that unites the area of nutrition with the area of speech therapy. Just this year we saw the treatment for dysphagia and I found its application to the recovery process from tuberculosis interesting.
	E 9	I chose "impact of alcohol consumption", a concept that unites the area of nutrition with that of medicine, because people who consume alcohol chronically have a deficiency in vitamins and minerals, which could interfere with the effectiveness of the medications used to treat the disease. Tuberculosis.

	E 10	I chose "assimilation and absorption" because it is closely related to our career, which is specifically the digestive tract where these 2 actions occur. It is also extremely important for the gastroenterology specialty of a doctor. I find it extremely important to address the different mechanisms that our body has to assimilate nutrients and absorb them.
	E 11	I chose the concept of "Side effects of antibiotic treatment" because one of the factors that can alter the microbiota is the consumption of antibiotics, which increases the risk of suffering from ECNT, which is why it is necessary to consume foods that benefit the microbiota.
Kinesiology	E 12	Add the concept of "respiratory functional reeducation" in the kinesiology section. The objective of this technique is to optimize the breathing process and promote better lung ventilation.
	E 13	Add the concept of respiratory physiotherapy in the interdisciplinary section between kinesiology and medicine, since this method is very useful to improve the recovery process from tuberculosis
	E 13	I added the concept of "Postural Drainage", since it is a method used to eliminate secretions that form due to tuberculosis, and I related it to medicine because they are therapies that are carried out together in health centers.
	E 14	I chose the concept of "diabetes" and positioned it as interdisciplinary between the kinesiology and nutrition sections because with kinesiological treatment the functional sequelae can be reduced to a minimum.
	E 15	I chose the concept of percussion and thoracic vibration together with speech therapy, since in an interdisciplinary way we can obtain better results in both the patient's phonation and breathing.
	E 16	Add the concept of "Bronchial Hygiene" from kinesiology since it is very important to keep the airways clean and free of secretions.
	E 17	I added the concept of "Complications in communication" from speech therapy and the relationship with kinesiology, being able to combine breathing and strengthening techniques and exercises.
	E 18	I selected the concept of "Fluidifying bronchial secretions" from the Kinesiology area because of the importance of this type of treatment for better oxygenation of the patient and for their organic functions to function in the most optimal way possible.
	E 19	Select the concept "tuberculin test" from the area of Medicine, since it seems to me to be a good method, in addition to conventional blood tests, to determine if a person is infected with <i>Mycobacterium tuberculosis</i> .
Speech Therapy	E 20	Undone
	E 21	Undone
	E 22	Add the concept of "voice characteristics" in the area of speech therapy. Determining the characteristics of the voice is important since this can help in obtaining a differential diagnosis.

7. PHASE 4 4 th week

Students should look carefully at the spider web for those concepts/constructs that were selected by more than one participant. Each student selects two and creates a prompt with them and

the concept of tuberculosis using an Artificial Intelligence (AI) chat. Approximately 20 words should be the expected length. and must include the result in the table where your last name appears.

Career	Student	Prompt
Medicine	E 1	"Adapt food and liquid textures for nutritional treatment according to the needs of the patient with dysphagia associated with tuberculosis."
	E 2	"Tuberculosis can cause breathing difficulties and antibiotic treatment can have respiratory side effects"

	E 3	"Tuberculosis can cause dysphagia and increase nutritional risk due to difficulties swallowing and absorbing nutrients."
	E 4	Dysphagia can be caused by complications of diabetes, and tuberculosis can further exacerbate this condition.
	E 5	Tuberculosis can weaken respiratory muscles and cause dysphagia, making it difficult to breathe and swallow properly.
Nutrition	E 6	"Tuberculosis can cause dysphagia, difficulty swallowing. "Proper treatment and careful nutrition are crucial for recovery."
	E 7	"Optimizing nutritional treatment in diabetes is crucial to strengthen the immune system and combat tuberculosis more effectively"
	E 8	"Evaluation of dysphagia in patients with tuberculosis: a crucial approach to prevent nutritional risk."
	E 9	"Tuberculosis may increase the risk of diabetes and nutrient malabsorption due to chronic inflammation"
	E 10	"Tuberculosis can cause intestinal malabsorption, affecting the assimilation and absorption of nutrients in the body"
	E 11	"Tuberculosis, diabetes and malabsorption can cause health complications due to interference with nutrition and the immune system"
Kinesiology	E 12	"Percussion and chest vibration can be useful in cases of accumulation of secretions in the lungs, as occurs in tuberculosis. These techniques help improve the mobilization of secretions and open the airways, facilitating expectoration and improving lung function."
	E 13	"Alcohol consumption impairs postural drainage and aggravates the repercussions of tuberculosis on the respiratory system."
	E 14	In patients with tuberculosis, the accumulation of secretions in the bronchi is common, so it is important to fluidize them and eliminate them through postural drainage.
	E 15	"Respiratory physiotherapy plays a fundamental role in the treatment of respiratory difficulties associated with tuberculosis"
	E 16	Tuberculosis can affect the voice (dysphonia) and swallowing due to inflammation in the larynx or pharynx. They can be treated with medication and speech therapy.
	E 17	"Proper treatment for Pott's disease is essential to control the infection and prevent nutritional complications."
	E 18	Tuberculosis and diabetes are diseases that require care. Tuberculin tests are essential to detect infection in diabetic patients.
	E 19	Respiratory Physiotherapy is one of the treatment techniques that we have to implement in patients with respiratory difficulties. This is key to recovery from the disease, being a very effective therapy for the control and recovery of patients with tuberculosis.
Speech Therapy	E 20	Patients with tuberculosis often have deficiencies in various aspects that can be addressed jointly by nutritionists and speech pathologists.
	E 21	Tuberculosis is an infectious disease that can affect the lungs and can have a significant impact on communication, especially in patients with pulmonary tuberculosis.
	E 22	It is important to assess nutritional risk and control diabetes in patients with tuberculosis for effective treatment.

Subsequently, they are invited to analyze the results of their classmates and together they select the most relevant one and place it in the first box.

Assessment of dysphagia in patients with tuberculosis: A crucial approach to prevent nutritional risk.

Then, based on this, they develop a research problem considering the aspects that are always considered. Place the result in the second box.

What is the relationship between the degree of dysphagia and nutritional risk in patients with tuberculosis over 18 years of age, in Mar del Plata, in the year 2023?

They transform that question into a statement and place it in an Artificial Intelligence chat requesting to make an image [9] inspired by the styles of famous painters [10,11].



8. CONCLUSION

The implementation of strategies that foster creativity and reflective thinking has been and remains a challenge for higher education teachers. And the question arises again: why innovate in education? Simply because this is the way to enter into the game of shaping the future in the face of a global landscape that presents dilemmas and challenges. In this type of activity, the processual evaluation of each of the students who participate in the experience is always necessary, in addition to the self-evaluation of the person who carries it out. In this way, strengths and weaknesses can be identified and adjustments can be made.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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