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Exploratory study on the training of science teachers in an interdisciplinary approach: case of training in health sciences at the higher institute of nursing and health techniques.

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Abstract— *In order to enrich the training of science teachers, who require a diversity of knowledge and a broad field of vision on several disciplines taught, we are studying the application of the interdisciplinary approach that could be a solution to the training program. For it "allows for the integration of several types of knowledge and skills, in the sense of helping to keep up with the evolution of knowledge and improve the teaching method, while promoting meaningful learning based on authentic situations"(4). In this context, we focus on the study of this interdisciplinary approach among health science teachers at the Higher Institute of Nursing and Health Technology (ISPITS Casablanca), where students are trained to become nursing professionals. Thus, we seek to know if these teachers practice the criteria of the interdisciplinary approach in this training, and if they take into account its added value to teaching. We try to detect if there is a coordination between actors prior to a collaboration between these stakeholders and if there is at the same time an integration of knowledge, which constitutes for us the project of professionalization in action (conceptualization in action) in clinical settings. Thus, to do this, we use the quantitative method by interviewing teachers using a questionnaire adapted and inspired by that of REGE COLET, to investigate the skills they were seeking to develop in real situations among the trainees(9). We are also*

trying to define this approach and give some insight into its interest in the acquisition of new teaching methods and to approach the paradigm of interdisciplinarity and show the interest there may be in its evaluation tools. Finally, an analysis of the description in relation to a reading grid developed from the pedagogical indicators of the interdisciplinary approach completes our study. The result of the calculation of the interdisciplinarity index of this training (Indid = (organization of knowledge) / (organization of work)) allowed us to deduce that the quality of this training is of a relational interdisciplinarity(9). an analysis of the description in relation to a reading grid developed from the pedagogical indicators of the interdisciplinary approach completes our study. The result of the calculation of the interdisciplinarity index of this training (Indid = (organization of knowledge) / (organization of work)) allowed us to deduce that the quality of this training is of a relational interdisciplinarity (9). an analysis of the description in relation to a reading grid developed from the pedagogical indicators of the interdisciplinary approach [1]completes our study. The result of the calculation of the interdisciplinarity index of this training (Indid = (organization of knowledge) / (organization of work)) allowed us to deduce that the quality of this training is of a relational interdisciplinarity (9).

Keywords— *Training, Science teachers, Interdisciplinary approach, Collaboration, Integration.*

1 Introduction

We have chosen this study to shed light on the following problem; several participants in scientific fields find it difficult to master the interdisciplinary approach in their didactic approaches(2), and seek to know a practical method to know if their training courses meet the principles of the interdisciplinary approach. At the same time knowing the degree of integration of knowledge from various disciplines, of interaction and collaboration between stakeholders(7).

To find a solution to this problem, we sought to answer the following questions:

1. How to differentiate between teaching by approaches; disciplinary, multidisciplinary and interdisciplinary (4) ?
2. Does study-based training meet the criteria for training based on an interdisciplinary approach or not?

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For this purpose, we have chosen to study training in nursing sciences and health techniques at ISPITS in Casablanca. We used the concepts adopted by Professor Nicole Rege Colet to calculate the interdisciplinarity index of this training. We were inspired by its tools to adopt a questionnaire that we planned to send to 45 teachers from the different sectors of the institute. To carry out this survey, we went to see them on site. This work took us a lot of time since we had to meet each teacher apart and find the ideal moment to introduce oneself, explain the interest and objective of our research, and give an overview on the approach. In total, we received responses from 39 teachers out of the 45 targeted. We used the Excel software for the calculation and analysis of the results, which allowed us to determine the dominant percentages which are the basic keys to find the values of the scores of the levels of the organization of knowledge and those of the work organization. Once these scores were translated on the evaluation sheet (see below, tables of organizational levels), they allowed us to define the degree and type of interdisciplinarity achieved and also to detect the strong and weak points when we interpreted the principles of integration and collaboration of the training studied which allowed us to determine the dominant percentages which are the basic keys to find the values of the scores of the levels of the organization of knowledge and those of the organization of work. Once these scores were translated on the evaluation sheet (see below, tables of organizational levels), they allowed us to define the degree and type of interdisciplinarity achieved and also to detect the strong and weak points when we interpreted the principles of integration and collaboration of the training studied which allowed us to determine the dominant percentages which are the basic keys to find the values of the scores of the levels of the organization of knowledge and those of the organization of work. Once these scores were translated on the evaluation sheet (see below, tables of organizational levels), they allowed us to define the degree and type of interdisciplinarity achieved and also to detect the strong and weak points when we interpreted the principles of integration and collaboration of the training studied(9).

Thus, we adopted its conceptual evaluation framework designed to study the balance between the organization of knowledge and the organization of the work of this training.

We presuppose the hypothesis that this training is based on teaching through an interdisciplinary approach. So there would be: integration of knowledge from several disciplines; interaction between learners and also interaction between learners and teachers of these various disciplines. And that there would also be collaboration between the teachers of these disciplines and collaboration between them and their learners.

We can use different research related to health, such as occupational health and safety in many studies that focus on the practices and policies addressed by academics in sociology and psychology (10), as well as other studies such as the impact of yogic practices on mental health (11).

2 Empirical study

In 1962, In the Structure of Scientific Revolutions Thomas Kuhn suggested that "For interdisciplinary work to be valid, it is not enough to borrow knowledge and ideas from one discipline to another nor to graft them one to another. the other, but it must result from the accomplishment of operations of change and reformulation in more or less autonomous, solid and integrated scientific groups, with their specific manner and methodology "(1).

In 1972, Professor Berger explains that "teaching through an interdisciplinary approach requires the integration of knowledge from several disciplines, collaboration between teachers and interaction between teachers and learners. It is used for problem solving, and aims to achieve a project "(6).

Some researchers have indeed remained in their comfort zones and have closed themselves off to any innovative idea and proposal far from their fields of research (view all academic innovations as a temporary effect, rather than taking advantage of them to improve their knowledge and their visions on the contemporary world and come out of their shells). Because several new studies show that there are few sectors where researchers work based on the theories and knowledge of a single discipline and cannot be enough of a limited vision or see from a single angle to find solutions to any problem(1).

To properly introduce ourselves into this study we found the need to show the apparent difference that there was between the various pedagogical issues of training approaches close to the interdisciplinary approach(5), in order to better familiarize stakeholders with the principles of the approach and remove any ambiguity attached to it. So for more clarification we propose the following definitions introduced by Jean Piaget in 1970 in his study on the epistemology of interdisciplinary relations which explains that, when training is based on:

- knowledge of a single discipline there is disciplinarity;
- the simple juxtaposition of disciplines there is multidisciplinarity;
- the interaction and integration of knowledge, know-how and know-how from one or more disciplines and collaboration between their stakeholders there is Interdisciplinarity

- a strong interpenetration between the components of several disciplines and that if the training is defined as an axiomatic common to a set of these disciplines, there is trans-disciplinarity.

All these definitions teach us that, the classification shown above includes: "the principle of the fact, that as we approach transdisciplinarity we note that there is an increasingly strong interpenetration of disciplines"(8).

In the same sense "LENOIR (1998) and THOMPSON KLEIN (1996) have often evoked the hypothesis that the interdisciplinary approach precedes the birth of a new discipline"(9), p43.

REGE Colet, explains by the scale of differentiation between pluridisciplinarity, interdisciplinarity and disciplinarity that there are: multidisciplinarity when the organization of knowledge is lower than the organization of work, interdisciplinarity when the organization of knowledge is neighboring of the organization of work and disciplinarity when the organization of knowledge is superior to the organization of work. And that there is a refinement of this scale when it comes to examining more closely the interdisciplinary construction and the level of disciplinary integration achieved. Thus, by analyzing the type of interaction postulated and the degree of interpenetration of the disciplines, three forms of interdisciplinarity will appear which are committed according to the objectives pursued and the frame of reference which are:

- "Relational interdisciplinarity schematizes the first stage just after the pluridisciplinary juxtaposition, it is the operation of the first relational connection between disciplines for the development of a set of conceptual connections;
- *Instrumental interdisciplinarity indicates the fact that disciplines converge towards the goal of solving a problem. It is said to be instrumental because the disciplines serve the problem;*
- *Structural interdisciplinarity represents the standard arrangement and readjustment of concepts and theories. It is the model of interdisciplinarity that requires the most change in disciplinary frameworks, which remain intact in the other two forms. It represents the framework of typical integration "*(9), p44

All these definitions will be used to analyze the results obtained during the calculation of the percentages of the responses obtained in relation to the questionnaire that we administered to the teachers of this training.

From the conception of teaching through the interdisciplinary approach of the same author, we have chosen her questionnaire model and her assessment tables of the levels of knowledge organization and work organization. So that we conduct an exploratory study on this training, deduce the type of teaching approach used and that at the end of the study we can carry out an analysis and see the possible limits of these instruments(9), Chap 8.

We analyzed the results of the responses to the questions relating to the four items relating to the organization of knowledge; and the four others relating to the organization of work, to calculate the interdisciplinarity index and determine what type of interdisciplinarity it is.

3 Materials and methods

As research methodology we used the quantitative method, establishing a questionnaire for a population of 45 teachers from various disciplines and we got the responses from 39 teachers. With the aim of measuring the degrees and importance of: - the integration of knowledge and collaboration between teachers; - interactions between teachers and learners. To deduce the interdisciplinary index of this scientific training, which is defined as follows:

$$\text{Indid} = \frac{Sum\ of\ knowledge\ organization\ scores}{Sum\ of\ work\ organization\ scores} \quad (1)$$

We based our questionnaire on the study of items which represent the educational indicators of the two organizations; knowledge and work, which are as follows:

"The questions relating to the pedagogical indicators (I) of the organization of knowledge, study 4 items are; that he (she) is:

- *(I) 1- the degree of integration of the contents / Integrating axis;*
- *(I) 2- the importance given to the problem-based learning approach / didactic model;*
- *(I) 3- the importance given to knowledge in the formulation of educational objectives / Educational objective;*
- *(I) 4- the importance attributed to the measurement of integrated knowledge during the evaluation of learning / Evaluation.*

The questions relating to the pedagogical indicators of the organization of work, study 4 items are; that he (she) is:

- *(I) 5- the degree of collaboration within the teaching team / teaching team;*
- *(I) 6- the degree of collaboration between students during learning activities / Teaching method;*
- *(I) 7- the degree of interaction between teachers and students / degree of interactivity;*

- *(I) 8- the importance given to the development of the frame / development of the frame"*(9), *chap: 8, p123.*

For each indicator, we used an ordinal scale for measuring the degree of integration and that of collaboration ranging from 1 to 4. The values of the scale correspond to the following modalities: 1 = weak integration or collaboration, 2 = average integration or collaboration, 3 = strong integration or collaboration, and 4 = strong integration or collaboration.

We used the Excel software to analyze the results and also for the establishment of diagrams and curves representative of the following results; see below.

4 Results

Fig. 1 represent the Answers concerning the educational levels of the organization of knowledge.

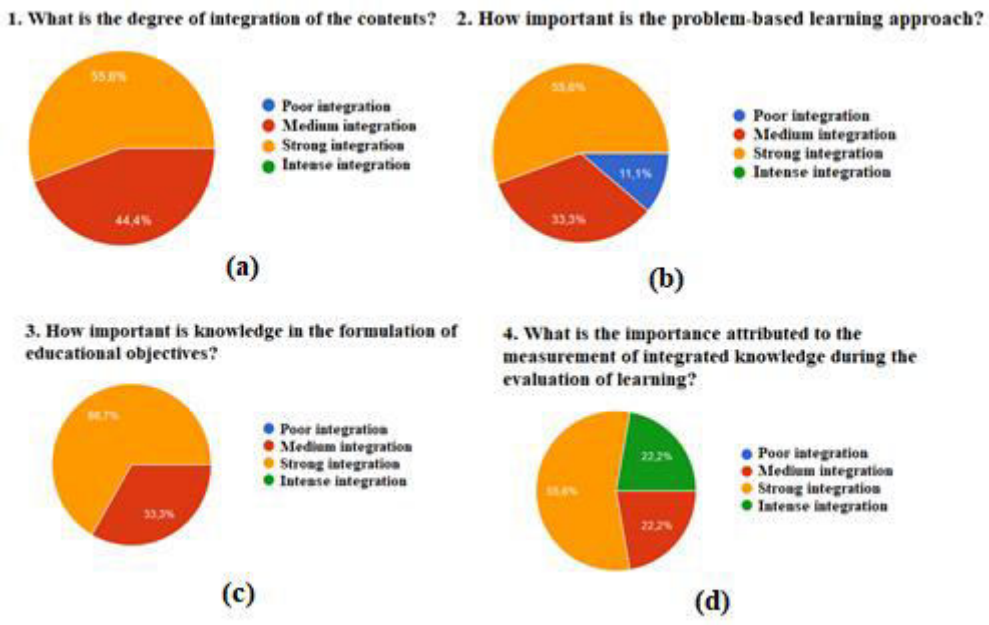

Fig. 1. (a) Content integrator axis: convergent approach, (b) Didactic model, or problem-based learning approach: Case study (c) Educational objectives and integrated knowledge: predominance of non-cognitive objectives> over cognitive, (d) Integrated Knowledge Assessment: Summative Integrated Knowledge Assessment

Table 1. Analysis of the results obtained by the Excel software based on the study of the educational levels of the organization of knowledge

	Percentage of responses					
Questions for teachers	Low	Way	Strong	Intense/ Important	The levels of the two organizations / the dominant teaching methods	
1- the degree of integration of content / Integrating axis	00	44.4	55.6	00	Content integrator axis: convergent approach	Organization
2- the importance given to the problem-based	11.11	33.33	55.6	00	Problem-based learning approach case study	

learning approach / didactic model						of knowledge
3- the importance knowledge in the formulation of educational objectives / Educational objective	00	33.3	66.7	00	Predominance of non-connective objectives> connectives	
4- the importance attributed to the measurement of integrated	00	55.6	22.2	22.2	summative assessment of integrated knowledge	

knowledge during the evaluation of learning / Evaluation						

Table 2. The result of the scores of the educational levels of the organization of knowledge

Level of knowledge organization			
1. Content integrator axis	**2. Didactic model, or problem-based learning approach**	**3. Educational objectives and integrated knowledge**	**4. Assessment of integrated knowledge**
1 Approach Encyclopedic	**1 Questioning**	**1 Only non-cognitive goals**	**1 No rating** learning
2 Approach Exploratory	**2 File or personal work**	**2 Only cognitive goals**	**2 Evaluation** Summative & disciplinary
3 Convergent ap-	**3** Case study	**3 Predominance of non-**	**3 Summative Assessment of**

proach ×	×	**cognitive objec-tives> over** cogni-tive ×	**Integrated Knowledge** ×
4 Integra-tive Ap-proach	**4 Investiga-tion**	**4 Many cogni-tive goals accom-panied by non-cognitive**	**4 Evaluation** Integrated knowledge train-ing
Score1 = 3	**Score2 = 3**	**Score3 = 3**	**Score4 = 3**
The sum of the scores is: 3 = 3 + 3 + 3 = 12			

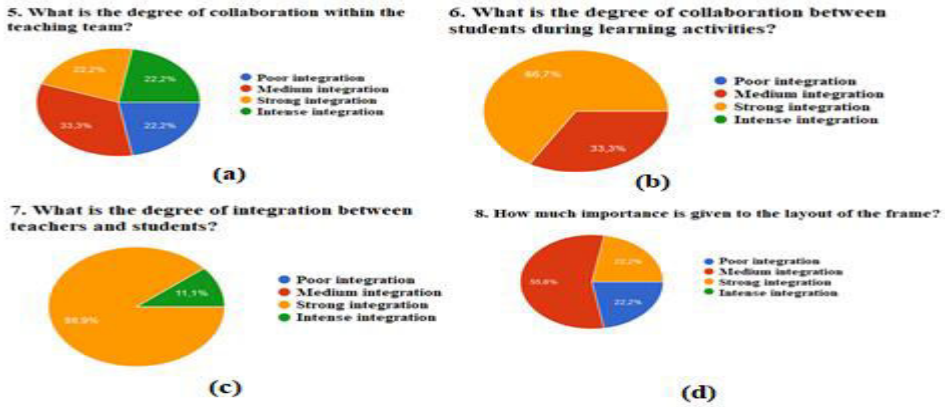

Fig. 2.(a) Collaboration of the teaching team: integration of content, (b) Didactic model, or problem-based learning approach: Work in small groups, (c) Interaction between student and teachers, degree of interactivity: strong interaction, (d) Framework development: Study plan integration.

Table 3. Analysis of the results obtained by the Excel software based on the study of the educational levels of work organization

Questions for teachers	Percentage of responses				The levels of the two organizations / the dominant teaching methods	
	Low	way	Strong	In-tense/ Important		
1- the degree of collaboration within the teaching team / teaching team	22.22	33.34	22.22	22.22	Content integration	work organization
2- the degree of collaboration between students during learning activities /	00	33.3	66.7	00	Problem-based learning approach: work in small groups	

Teach-ing method						
3- the de-gree of inter-action be-tween teach-ers and stu-dents / degree of in-terac-tivity	00	00	88.9	11.1	De-gree of interac-tivity: strong interac-tion	
4- the im-portanc e given to the devel-opment of the frame / devel-opment of the frame	22 .2	56.6	22.2	00	Study plan in-tegration	

Table 4. The scores of the educational levels of work organization

Work organization level			
5. Collaboration of the teaching team	**6. Collaboration between students, teaching method**	**7. Interaction between student and teachers, degree of interactivity**	**8. Setting up the frame**
1 Educational planning	1 Teaching Frontal course	1 Weak interaction	1 Schedule
2 Integration of content ×	**2 Large group work**	**2 Mediumour** interactions	**2 Integration** study plan ×
3 Education (animation)	**3Work in** small group ×	**3 Strong interactions** ×	**3 Non-executive activity**
4 Evaluation	**4 Culminating activity** or synthesis	**4 Intense** interaction	**4 Additional Resources**

Score5 = 2	Score6 = 3	Score7 = 3	Score8 = 2
The sum of the scores is: 2 + 3 + 3 + 2 = 10			

4.1 Results interpretation

Following the results found, we transfer the percentages of the dominant responses shown in blue on the evaluation sheet "which not only allows us to define the degree and type of interdisciplinarity achieved, but it also highlights the strengths and gaps possible in the interpretation of the principles of integration and collaboration "(9), p 132. To find the dominant scores in the two organizations, we read the values of these scores on the table representing the level of organization of knowledge and on that representing the level of work organization.

We check with a cross on the boxes which represent the level of each of the two organizations translated by the dominant percentages of the responses, which are indicated by the numbers from 1 to 4, values of the degree of interaction or collaboration dominates. These same values also show us the dominant pedagogical type that we can read in each of the two tables.

4.2 Results analysis

Analysis of the results: The calculation of the interdisciplinarity index (9) of this training depends on the values of the scores presented by the ordinal scale measuring the degree of integration and that of collaboration ranging from 1 to 4. These scores are found when calculating the percentage of responses and looking for those who are dominant and which we pass on the table levels of organizations.

The sum of the dominant scores for the organization of knowledge is: 3 = 3 + 3 + 3 = 12

The sum of the dominant scores for the organization of work is: 2 + 3 + 3 + 2 = 10

(Indid = Sum of the scores of the indicators of the organization of knowledge / those of the organization of work)

$$\text{Indid} = = 12/10 = 1.\ 2\frac{Sum\ of\ knowledge\ organization\ scores}{Sum\ of\ work\ organization\ scores} \quad (2)$$

According to the table of values of the intervals of interdisciplinary relations, it "There are:

- *Multidisciplinarity if Indid<0.75*
- *Interdisciplinarity if Indid = [0.75, 3] = confidence interval*
- *Disciplinarity if Indid> 3*"

The scale proposed by (3)which defines the interdisciplinary confidence interval between 0.75 and 3; translates it as follows and that if it is:

- *"0.75 to 1.5 then the training is of relational interdisciplinarity;*
- *1.5 to 2.25 then the training is instrumental interdisciplinarity;*
- *2.25 to 3 then the training is structural interdisciplinarity".*

Our presupposition that training could be interdisciplinary is approved, because the total score of the organization of knowledge is close to that of the organization of work.

The interdisciplinarity index is close to 1, it is 1.2

It reveals to us that this training is of a relational interdisciplinarity, because there is neither intense integration of knowledge between disciplines, nor significant collaboration between the speakers of the different disciplines nor intense interaction between teachers and learners, and nor a significant collaboration and integration between them.

5 Conclusion

Following a well-extended bibliographic study, we chose to use Nicole Colet's conceptualization for the study of this training, the educational principles of which seemed to us to be closer to those of training through the interdisciplinary approach. Because reliable methods and systems of evaluation structures for interdisciplinary education are rare. This methodological deficiency is the consequence of a lack of conceptualization of interdisciplinary teaching and of formalization of its practices. We started by defining the basic principles of the approach, introduced the tools used in the conceptualization chosen to finally calculate the interdisciplinary index of the training, and deduce its basic pedagogical approach.

The Indid depends on the balance between the organization of knowledge and the organization of work. Each imbalance in the two organizations can change the modalities of training.

A good training by the interdisciplinary approach requires a mastery of its concepts and its principles. Training based on this approach must include an intense integration of knowledge from several disciplines as well as intense collaboration between stakeholders. We had to choose to do this experiment in order to know the degree of integration of the knowledge of

the different disciplines that make up this training as well as the degree of collaboration between the participants in this training. We arrived at the results that the training is of a relational interdisciplinarity, but what interests us most is that we found, according to the dominant percentages of the answers, that there is a strong integration of knowledge and an average collaboration between teachers in this training.

This prospective study on teaching approaches in this branch of training reveals to us that there is a need for further research on training through the interdisciplinary approach. And so there is an obligation to integrate it into other branches of education, in order to give it more value and credibility to take it as a model for evaluating university teaching approaches.

This approach could be better applicable in all fields of science education when the speakers are trained, familiarized and motivated to use its basic concepts.

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