

## Knowledge about the lack of knowledge of teaching job

<sup>1</sup>ARMAND, <sup>2</sup>André TOTOHASINA

<sup>1</sup>High School Antsiranana B.P. 234 Antsiranana Madagascar.

<sup>2</sup>Department of Mathematics and Informatics

Superior Normal School for Technical Education (S.N.S.T.E.)

University of Antsiranana B.P.0 - Antsiranana Madagascar

---

**ABSTRACT:**In the field of education, whether in High School and University, several people think that the provision of academic skills and intuitive knowledge are sufficient to face the teaching profession. It seems that to teach well, it would be enough to master his subject, to have disciplinary University knowledge to transmit. The rest would be innate, no doubt? Funny job, which does not know professional "gestures", which would not require continuous training. This paper explains the relationships between intuitive knowledge and how to teach it.

**KEY WORDS:**Teaching learning, Establishment effectiveness

---

### I- INTRODUCTION

In companies work around quality. Whether for the sale of products or services, quality is ubiquitous. In business, the notion of quality comes from Taylorism, a movement that advocates the "best way to produce". Companies want to produce a quality product or service that meets the demand and needs of consumers. In a company, the quality management concerns the organization as well as the production (Ball, D. L., & Cohen, D. K. 1999), (Crotty, M. 1998), (Bogdan, R., & Biklen, S. 1994), (Esteban, M. P. S. 2010), (Even, R. 1990), [Ric05], (Goldsmith, L. T., Doerr, H. M., & Lewis, C. C. 2014), and (Mestre, C. M. M. V. 2014). In our life, there are many types of businesses, we can't name all kinds of businesses in our lives, but everyone knows that a school institution is among class "public company". That is to say, it is a company called "establishment" or "institution" with legal personality and financial autonomy in the public sector and carrying on an industrial and commercial activity. It is increasingly rare for the state to manage its economic activities directly "in-house", as commonly used. It is essentially through the public enterprises that this management takes place.

The creation of relatively autonomous institutions is by far the most practiced (Murata, A. 2011), (O'Donnell, B., & Taylor, A. 2007), (André Luis Trevisan, Alessandro Jacques Ribeiro, João Pedro da Ponte. 2019). All establishments aim to train persons or managers considered competent to manage any establishment including a school. As UNESCO (United Nations Educational, Scientific and Cultural Organization) launched what is called CONFES (Conference of Francophone Youth and Sports Ministries) [UNE11] then, the stewardship of an institution (even stewardship of a person) requires more and more professional skills to achieve the objectives in the so-called sphere. Afterwards, it is clear that there are several modes and/or ways even educations on the management of an institution to make it effective. Subsequently, several people think that the provision of academic ability and intuitive knowledge are enough to face the teaching profession. It seems that to teach well, it would be enough to master his subject, to have disciplinary university knowledge to transmit. The rest would be innate, no doubt? This paper explains the relationships between intuitive knowledge and how to teach it.

### II- KNOW-HOW

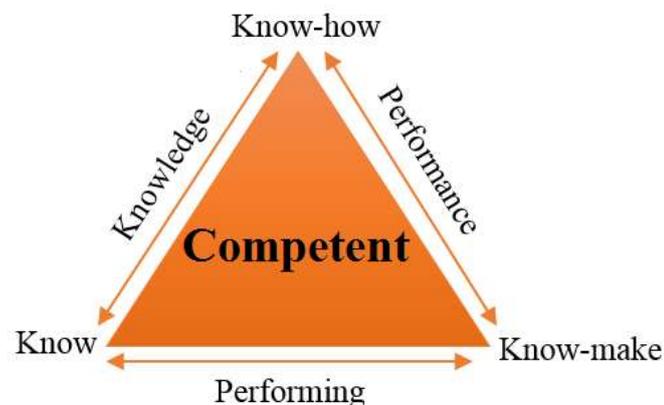
One of the most important factors for the human being is the ability to answer the question "who am I?" to everyone in front of him. Answer the question "who am I?" is one of the simplest objects considered for everyone, because everyone thinks he knows his own person perfectly. A person asking a question can expect a variety of staggered responses after analyzing the ways to launch the question. It should be emphasized here that the person asking the question is none other than himself. From there, it is clear that an answer relating to one's own civil status is to be excluded. It should also be emphasized that the study affects every active individual, from the learner to the villagers. Affirm it: "If you live, it is often among people who are like you". Moreover, according to a dogmatic reasoning not insignificant, this may be from the law of nature, "we only harvest what we planted". The goal is to have good results coming out in good faith, but this requires great effort. The answers to the question each have their explanation according to their level, but only they all rest on the same subject. I will answer the question in accordance with my own teaching. Afterwards, it is clear that the obvious answer will be: "I am a teacher". The profession of being a teacher is subject to several environments such as: academic capacity, institution, administrative and technical staff, and especially "learner". I lose my reason "to be a teacher" without these three big entities. We know that each of these entities has its own activities, but we still recognize that of learners has a higher coefficient. So, for us teachers, it would be good to emphasize that we

are the first responsible for the existence and good education of these learners, education that will turn them into responsible in the future. If the academic capacity is acquired, and the institution is there, but there are no learners, the teacher has no reason to be! The converse is not necessarily true. Indeed, many people think that they automatically become teachers as soon as there is a school and corresponding academic capacities. The answer is no. In the field of education, we note a significant number of teachers who perform the job purely for a purely financial purpose, without thinking of a better future for learners; therefore, they do not seek to know where their students left, who are they and what are they for? In a summary way, when we enter a classroom, or in our office, or elsewhere, we must always look for the best ways to do the right thing for the learners so that they can make good profits. And the following questions must remain permanently in our mind: "Why do I practice this teaching profession? Who are these learners?" Do they see me? Do they hear my way? ". In this respect, the purpose of research in the field of knowledge-based education is to find all the pedagogical means enabling learners to love and / or acquire at best the control of actions and reactions adapted to their organization and their environment. Among the themes of the "Know-how", personal development finds its place, but not only. Other themes are indicative of a "know-how" as themes related to the following themes:

- preservation of the environment: to self-guarantee the durability or integrity of all the characteristics (social, family or economic) specific to a specific environment;
- hygiene: to self-install sets of educational, psychological and medical measures for the development and preservation of good psychic and emotional health;
- empathy: to self-dispose the intuitive faculty of putting oneself in others' shoes and understanding one's feelings and emotions;
- emotional control: to self-control the characters of a sudden and more or less intense emotional affective disorder;
- behavioral control: to self-placing psychotherapy intended to treat by modifying maladaptive or disabling behaviors, using in particular techniques of desensitization and deconditioning;
- accountability: to self-empowerment;
- pro-social actions: to self-realization concretely and generally ordered of a will;
- cooperation: to mutual self-support for a common purpose;
- conflict resolution: to self-determination and closure of decisions necessary for antagonism;
- stress management: to self-manage the continuous or repeated tension of a physical or psychological nature;
- Active listening: to self-having the ability to listen and criticize them from time to time in order to give constructive criticism.

Learning techniques in this field are still only weakly formalized, that is, taught as such, but tend to develop. There are many methods on this subject on the Internet, adapted to a very wide range of "soft skills".

**Warning!** We sometimes oppose the know-make to know-how. They do not oppose each other, but on the contrary articulate and complement each other with the third vertex of the competence triangle with knowledge or knowledge more theoretical and far removed from practice (see Figure 1.).



**Figure 1.–Triangle of competence**

Indeed, the know-how refers to all the operational skills related to the exercise of a profession. However, there is no competence outside the context in which it is exercised; and all relational mode at work is crossed by operational. However, everyone has his field; and that of the "know-how" is the relationship that accompanies the exercise of know-how.

So it could be defined as an art of conviviality with its partners. In the Anglo-Saxon culture, we speak of "soft skills" as opposed to the term "hard skills", the know-how. It focuses exclusively on the skills defined by:

- problem solving: full of self-determined and firm decisions (taken after reflection) worries arising from an unsatisfactory state of affairs;
- trust: full of faith in personal integrity;
- emotional intelligence: full of individual ability to think and understand about the release of characters from a sudden and more or less intense emotional affective disorder;
- empathy: full of the intuitive ability to put oneself in others' shoes and understand their feelings and emotions;
- communication: full dissemination of information or branding to the public;
- time management: full of self-discipline mastery of particular state of sunlight or atmospheric disturbances;
- stress management: full of self-discipline of continuous or repeated tension, physical or psychological;
- creativity: full of the power to invent or create;
- entrepreneurial spirit: full of intellectual or moral aptitude to begin the realization or the execution;
- Boldness: full of the qualities of people acting with boldness and determination despite the dangers and obstacles;
- motivation: full of stimulations of wills giving a reason to act;
- vision, visualization: full of perception by the eye of the outside world;
- the full presence of attentions related to availability;
- the sense of the collective: full of ideas to realize or practice in common or in team;
- Curiosity: full interest aroused by the desire to know.

In a word, the know-how and/or personal qualities correspond then to the capacity to produce actions and reactions adapted to the human and ecological environment. This capacity is acquired in part by the knowledge of specific behavioral knowledge in a social actor situation.

### **III- INTUITIVE KNOWLEDGE AND TEACHING SKILLS**

Absolutely, the resolution of a concrete problem requires the application of an intuitive and clear consciousness of the object at disposal. In mathematics, for example, it is generally reflected in the application of prior learning or in the practice of knowledge or skills of mathematical data sets forming the necessary and satisfactory designed response. Such an object certainly requires a category of knowledge, and an innate ability (intuitive knowledge) appears to be the best placed! Knowledge-intuitive is indeed a knowledge. However, said knowledge does not always mean automatic knowledge transfer capability. Ability is ability in the field of thought, feeling or action or the disposition of the properties that a container or room offers to accommodate any content. To this end, Richard E. Nisbett has defined that intelligence is today defined as the set of nine mental abilities, namely Ribeiro, A. J., & Ponte, J. P. (2019):

- the ability to reason logically: to have the ability to develop reasoned argumentation in accordance with what is expected, given the facts or circumstances and / or in accordance with reason and common sense;
- ability to predict: to have an ability to:
  - decide for the future something or do something;
  - consider as probable of a future event;
  - imagine in advance of a future event;
  - consider possibilities or probabilities;
  - judge a quantity or duration necessary for something or do something;
  - design something for a particular purpose or purpose;
  - bring something;
- Ability to model mathematically or abstract: to have the ability to create a standard representation in order to predict the evolution of the rules of mathematical science;
- Ability to solve problems: to have an ability to self-identify and close (taken after thinking) worries arising from an unsatisfactory state of affairs;
- ability to grasp and interpret complex data: to have an ability to grasp intelligence and to clarify and explain data composed of many elements that form a difficult set to be feared;
- ability to learn fast: to have an aptitude to learn quickly;
- ability to learn through experience: to have an aptitude to learn through practice that allows one to acquire over time a know-how or a knowledge of life;
- Ability to cope with a variety of situations: to have an ability to cope with a variety of situations;
- Ability to adapt to situations: to have the ability to assemble by adjusting to existing sets of conditions.

Moreover, intelligence is the ability and /or individual and /or mental wealth to reflect and understand, or the human faculty to learn, understand and relate to things, the whole of possibility of understandings (Shulman, L. 1986), (Silver, E. A. 2009). On this subject, the literature certifies that there are eight kinds of intelligence namely:

- Linguistic intelligence: rich in the technique of self-manufacturing and/or developing and even exploring the means of expression and communication between people and/or in the language sciences that scientifically studies language and languages;
- Logic-mathematical intelligence: rich in the technique of self-fabricating science that studies the laws of reasoning belonging to the field of mathematics;
- Musical intelligence: rich in technique of self-stacking the art of combining sounds or noises between them, in their respective durations and in the passage of time;
- Spatial intelligence: rich in technique of self-forecasting absolutely space devices;
- Kinesthetic intelligence (Somatonic): rich in technique of self-reporting to kinesthesia (perception of movements of different parts of the body);
- Intra-personal intelligence: rich in the technique of self-dreaming projects and goals and acts accordingly to achieve them;
- Interpersonal intelligence: rich in the technique of self-interesting relations between individuals;
- Ecological Intelligence: rich in the technique of self-studding of the science of the earth concerned with preserving a natural balance between living beings and their environment;

Subsequently, "is it enough to know to know how to teach? It seems that in order to teach well, one would have to master one's subject, to have disciplinary university knowledge to transmit. The rest would be innate, no doubt?"

Funny job, which does not know any "gestures" professionals, which would not require continuing education ... And if teaching was rather a profession that can be learned. Allow your servant to believe that a teacher who dominates more than another subject, if he acquires the very specific art of teaching, will always be the best of pedagogues, and that aggregation is the gift that the nation makes to its children, to offer them, poor or rich, what is best.



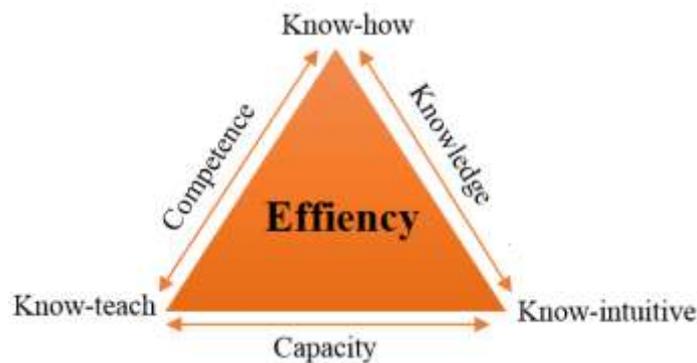
**Figure 2. – Good students debate**

The debate is old as teaching. The " teacher " teaches his disciples who listen to his word and thus learn. This image inherited from antiquity continues to permeate the spirits. The creation of aggregation 250 years ago corresponds to this logic: "academic excellence" is then the only way to define the teacher. The Capes is created in 1950 but does not include tests on the ability to teach (Silver. E. A., Clark, L. M., Ghouseini, H. N., Charalambous, Y. C.,& Sealy, J. T., 2007), (Smith, E. 2008), (Smith, E., &Confrey, J. 1994).

Yet, for a teacher to integrate effectively in the context of "his new job", within the educational system as a whole or across his school, it is important that he has a clear idea and what the state expects from it, the values of the system of which it is now a member, the essential skills that it is supposed to implement, the values that it must convey, and that all this constitutes for it a kind "contract" or "charter" with his employer and with the Nation. Report of the National Committee for monitoring the reform of the training of teachers and education staff, chaired by Daniel Filâtre, towards a new model of lifelong learning. Knowing how to teach is therefore also a knowledge. It is not only the product of the experience because it must be formalized and be the subject of a reflexive process. There is nothing more practical than a good theory but there is nothing more theoretical than

a good practice, said the psychologist Kurt Lewin. Thinking of one's practice is not only learned, but it is best done in confrontation, cooperation and mutualisation. There is also a need to understand the functioning of the brain, the mechanisms of learning and attention, and the social mechanisms that can affect students. And also know the functioning of this particular being that we sometimes tend to forget when we are adults: the child, the teenager...

And it is worth remembering that the teaching profession is not limited to the mere transmission of knowledge but that it also has many other dimensions that must be learned: working with parents, partnership, lead projects, meetings, allow the orientation of students ... Finally, even if we consider that only knowledge is useful to teach, it should in any case update and renew them. But more generally, we must admit that we are not trained once and for all. Initial training should only be considered as a stage: all staff should be entitled to substantial continuing training. Would you entrust your health to a doctor who would boast of never having trained since graduating from medical school? Teaching is a profession that is learned, collectively and all the time!



**Figure 3. – Efficiency triangle**

In the end, an "expert", a scientist, is not necessarily a good teacher (intuitive knowledge). Certainly, it is important to know his teaching discipline, if only to feel comfortable and that it is seen in the classroom. Discipline problems are often problems of discipline! Then, it is important to be passionate about sharing the "flavor of knowledge". But there is obviously a lot of didactic transposition work: knowing how to organize a sequence of courses, choosing the order of concepts and methods, identifying resistances and difficulties in learning, all this is learned and not innate.

#### **IV- TASKS OF TEACHERS FACING HIS LEARNERS**

- **Help learners**

One of the strictest duties of the teacher is to help his learners as they play him the gown. This duty is not easy. It requires time, practice, dedication, and good principles [Pol65]. The learner must acquire the widest possible experience of personal work. But if he remains alone in front of his problem, without any help, or with insufficient help, he can make absolutely no progress. On the other hand, if the teacher helps too much, he has nothing left to do. The teacher must help him, neither too much nor too little, so as to leave him a reasonable job. If the means of the learner are limited, the teacher must at least keep the illusion that he is providing a personal work; to do so, he must help him in a discreet way, without imposing himself on him [Pol65], [Enr90]. The best is to help the learner in a natural way. The teacher must put himself in his place, examine his particular case, try to understand what is going on in his mind, ask a question or indicate a stage of reasoning that might have come to the mind of the learner himself. Question, recommendation, intellectual operation. In trying to help the learner in an effective and natural way, but without imposing on him, the teacher is constantly brought to the same questions, to constantly indicate the same stages of reasoning. Thus in innumerable problem, we must ask the question: what is the unknown? We can vary the vocabulary, ask the same question in a different way: "what do we ask for? What do you want to find? What are you supposed to have searched for?" The purpose of these questions is to force the learner to focus on the unknown. Sometimes we get the same result in a more natural way by suggesting: Look well at the unknown. Question and suggestion are aimed at the same goal: they tend to provoke the same intellectual operation. Remember that a teacher must have styles of paternalistic and democratic leadership.

#### **V- EIGHT TECHNIQUES TO TEACH SOMEONE SOMETHING**

Stéphane Edoard gave eight techniques to teach something to someone who follows (<https://www.hommesdinfluence.com>).

### **5.1. Your passion is your enemy**

When you have developed a lot of knowledge in one area, it's probably that you like it in the same proportions. The pupil is still at the stage where he does not know if he will like you one day, and from the start this gap separates you. Always assume that in principle, unlike you, a student does not experience (as much) pleasure in the tasks you ask him to do. You will avoid that he feels too big a gap with you.

### **5.2. Make it rephrase**

Everyone knows how to listen by looking interested. We did it all, especially for example during a meeting "in love" that had only the name. Never assume that a student has understood because he is telling you. He may be sincerely persuaded himself, but always ask him to rephrase, to "do his words." It is during the reformulation phase that he will lift (and solve) his own blockages and integrate the information.

### **5.3. Anticipate the difficulties**

Forget what you know about your discipline and look at it with the eyes of an "ignorant". Where did you experience difficulties when you learned it? It is 99.9% likely that your listener meets (at least) the same, so anticipate by slowing down on these specific points and ask him to redouble his attention. Make sure that the previous point is "closed" (by having it rephrased) before addressing a new difficulty, and reassure him that you will spend all the time necessary, to take away the pressure implied to have to understand the first time.

### **5.4. In the first explanation, prune as much as you can**

Your "verbatim" knowledge of the problem makes you think in advance of a thousand nuances and details that the person who faces you has no idea, and that she does not have to know for the moment because they would not than confuse it. The first time you explain something to someone, skip all the details that might slow down their understanding, give them only the big picture. In the same way, always ask him what he wants to do in the end with what you teach him, this is the best way to prioritize and build your personalized plan.

### **5.5. On thing has name (and the guard)**

Your experience in the given field often leads you to juggle without thinking with the lexical field, swapping the words while always knowing what you are pointing to. Think that, for your interlocutor, everything is new, even the words! I was recently taking Photoshop training and my coach for the occasion alternately used the terms "work areas" and "background" as perfect equivalents, to the small detail that he had forgotten to tell me! Whatever you explain to a beginner, one thing has a name and only one. No two.

### **5.6. If an explanation does not "fit in", change the explanation!**

Perhaps the most important point. If the definition of the concepts does not have to change any more (see preceding point), the key consists on the other hand to vary the way of explaining. The popular saying that pedagogy necessarily passes by repetition is incomplete: used alone, the "beast" repetition has never been a pedagogy in itself! My boxing teacher pointed out to me that my hooks were not up to my direct (literally and figuratively) and I had trouble correcting them. It was dozens of times he told me to bring the forearm parallel to the ground but it did not happen, I was (or rather, my channel) "plugged". I then asked him, sweaty but jokingly, to explain it to me in another way. With other words, another picture. New version: "act like you're nudging". Result I understood. I miss, again, sometimes, but I understand correctly.

### **5.7. Use analogies, or the power of "act as if"**

Remember that the person who faces you, as novice as it is on the subject of the day, is expert in others of which you probably do not know anything. Or not much. Take advantage of this "capital" by using images: "act as if". To a child who learns the piano, to "pass the thumb": "act as if you wanted to hide it under the palm of your hand". To a singing student, to learn "low breathing": act as if you inflate a balloon under your belly button, etc.

### **5.8. Learn vs (volunteer for a service) admire, everything in its own time**

You are not aware of it, but in his eyes you are a virtuoso in your field, and the few basic manipulations that you could unconsciously give yourself in front of him already greatly impress him. Do not show off your "virtuosity" (even relative) during the explanation, it deconcentrates the learner. You can't admire and learn simultaneously. Everything in its time. If you learn computer science to someone, for example, try not to use the many keyboard shortcuts you know, you will lose it immediately. In the end, you now know the basics of

pedagogy. So call your teen, confiscate his iPhone for 15 minutes, and teach him something you like! To transmit is a pleasure without equivalent.

## **VI- LEARNERS FACING A PROBLEM**

### **5.1. Understand problems**

A high man, faced with a problem, must have the following questions in his head so that he can easily find the way in which he can consult the facilities and difficulties of the said problems. This is affordable for any discipline. As we have a famous proverb about problem solving that says, "A well-posed problem is half solved."

- What is the unknown? What are the data? What is the condition?
- Is it possible to meet the condition? Is the condition sufficient to determine the unknown? Is it insufficient? Redundant? Contradictory [Mau94], [Enr90]?
- Draw a figure. Enter the appropriate notation.
- Distinguish the various parts of the condition. Can you formulate them?

### **5.2. Design a plan**

- Have you met him before? Or did you encounter the same problem in a slightly different form?
- Do you know a problem? Do you know a theorem that can be useful?
- Look closely at the stranger and try to think of a problem that is familiar to you and has the same or a similar unknown.
- Here is a problem related to yours that you have already resolved. Could you use it? Could you use his result? Could you use his method? Would you need to introduce any auxiliary element to be able to use it?
- Could you state the problem differently? Could you put it in another form yet? Reporter to the definition.
- If you can't solve the problem that is being proposed to you, try to solve a problem that is related to it and that is more accessible? A more genital problem? A more particular problem? A similar problem? Could you solve some of the problem? Look only at one part of the condition, neglect the other part; to what extent is the unknown, then determined, how can it vary? Could you draw data a useful element? Could you think of other data that could help you determine unknowns? Could you change the unknown, or the data, or both if it is necessary, so that the new unknown and the new data are closer to each other?
- Have you used all the data? Have you used the whole condition? Did you take into account all the essential notions of the problem?

### **5.3. Put the plan into execution**

In carrying out your plan, check each detail one after the other. Can you clearly see if this detail is correct? Can you demonstrate that it is correct?

### **5.4. Return to the solution**

- Can you check the result? Can you check the reasoning?
- Can you get the result differently? Can you see it at a glance?
- Can you use the result or method for some other problem?

## **VII- CONCLUSION**

In sum, the foundation for having a successful business (see an institution) depends on several components and / or building blocks and even characteristics of the human being. Introducing skills is a really difficult task. In a school institution, different disciplines are taught, the actors of all these disciplines must pedagogically show a good collaboration. Note that in a classroom (in the broadest sense) there are different kinds of people, namely very curious and passionate people, people who need deep and detailed quarrels to grab what they need and people say curious, but who misuse their intelligences: they use it for other purposes and not for the purpose of their training. In general, in spite of their strong character differences, each one has his own personalities, each educator must know at least of these three characters, because in all cases he is the first person to remedy them. Also, a good education and/or management requires a good teacher and/or a good trainer. It is for this reason that UNESCO has launched the qualitative challenge of teachers. We have also seen that in terms of the efficiency of a class and/or company, the personnel (in general being human) occupy a very large place. Thus, if one reflects on the field of mathematics education in the schooling of primary-school-high school basics, then it is still teaching in the stimulation phase. Faced with the problem, we will present some proposals that may, among other things, "serve" and/or "stimulate" the spirit of the teachers, in particular the college, towards

objectives that are appropriate to the need of our corresponding country and considered as a complementary challenge. of mathematics education of UNESCO.

#### REFERENCES

- [1]. André Luis Trevisan, Alessandro Jacques Ribeiro, João Pedro da Ponte. (2019). Professional Learning Opportunities Regarding the Concept of Function in a Practice-based Teacher Education Program. *International Electronic Journal of Mathematics Education (IEJME)* E-ISSN: 1306-3030. 2020, Vol. 15, N<sup>o</sup>. 2, em0563 <https://doi.org/10.29333/iejme/6256>.
- [2]. Ball, D. L., & Cohen, D. K. (1999). Developing practice, developing practitioners: Toward a practice-based theory of professional education. In G. Sykes & L. Darling-Hammond (Eds.), *Teaching as the learning profession: Handbook of policy and practice* (pp. 3-32). San Francisco, CA: Jossey Bass.
- [3]. Bisognin, E., Bisognin, V., & Cury, H. N. (2010). Conhecimentos de professores da educação básica sobre o conceito de função. In *Anais do X Encontro Nacional de Educação Matemática*. Brasília, SBEM.
- [4]. Bogdan, R., & Biklen, S. (1994). *Investigação qualitativa em educação*. Porto: Porto Editora.
- [5]. Crotty, M. (1998). *The foundations of social research: meaning and perspective in the research process*. London: Sage.
- [6]. Esteban, M. P. S. (2010). *Pesquisa qualitativa em educação: fundamentos e tradições*. Porto Alegre: Artmed.
- [7]. Even, R. (1990). Subject matter knowledge for teaching and the case of functions. *Educational Studies in Mathematics*, 21(6), 521-544. <https://doi.org/10.1007/BF00315943>.
- [8]. Goldsmith, L. T., Doerr, H. M., & Lewis, C. C. (2014) Mathematics teachers' learning: a conceptual framework and synthesis of research. *Journal of Mathematics Teacher Education*, 17, 5-36. <https://doi.org/10.1007/s10857-013-9245-4>.
- [9]. Mestre, C. M. M. V. (2014). *O desenvolvimento do pensamento algébrico de alunos do 4.º Ano de escolaridade: uma experiência de ensino* (Ph.D. Thesis in Education), Universidade de Lisboa. Lisboa.
- [10]. Murata, A. (2011). Introduction: Conceptual overview of lesson study. In: L. Hart, A. Alston, & A. Murata (Eds.), *Lesson study research and practice in mathematics education* (pp. 1-12). Dordrecht: Springer. [https://doi.org/10.1007/978-90-481-9941-9\\_1](https://doi.org/10.1007/978-90-481-9941-9_1).
- [11]. O'Donnell, B., & Taylor, A. (2007). A lesson plan as professional development? You've got be kidding. *Teaching Children Mathematics*, 272-278.
- [12]. Ribeiro, A. J., & Ponte, J. P. (2019). Professional learning opportunities in a practice-based teacher education program about the concept of function. *Acta Scientiae*, 21, 49-74. <https://doi.org/10.17648/acta.scientiae.v21iss2id5002>.
- [13]. Serrazina, L. (2017). Planificação do ensino-aprendizagem da Matemática. In: GTI (Ed.), *Aprática dos professores: planificação e discussão coletiva na sala de aula* (pp. 9-32). Lisboa: APM.
- [14]. Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4-14. <https://doi.org/10.3102/0013189X015002004>.
- [15]. Silver, E. A. (2009). Toward a More Complete Understanding of Practice-Based Professional Development for Mathematics Teachers. In: R. Even & D. L. Ball (Eds.), *The Professional Education and Development of Teachers of Mathematics: the 15th. ICMI study* (pp. 245-247). Springer. [https://doi.org/10.1007/978-0-387-09601-8\\_25](https://doi.org/10.1007/978-0-387-09601-8_25).
- [16]. Silver, E. A., Clark, L. M., Ghouseini, H. N., Charalambous, Y. C., & Sealy, J. T. (2007) Where is the mathematics? Examining teachers' mathematical learning opportunities in practice-based professional learning tasks. *Journal of Mathematics Teacher Education*, 10(4-6), 261-277. <https://doi.org/10.1007/s10857-007-9039-7>.
- [17]. Smith, E. (2008). Representational thinking as a framework for introducing functions in the elementary curriculum. In: J. J. Kaput, D. W. Carraher, & M. L. Blanton (Eds.), *Algebra in the early years* (pp. 133-160). Reston, VA: NCTM. <https://doi.org/10.4324/9781315097435-6>.
- [18]. Smith, E., & Confrey, J. (1994). Multiplicative structures and the development of logarithms: what was lost by the invention of function. In: G. Harel, & J. Confrey (Eds.), *The development of multiplicative reasoning in the learning of mathematics* (pp. 333-360).
- [19]. UNESCO. (2011). Les défis de l'enseignement de mathématiques dans l'éducation de base.