

PRE-ANALYSIS OF TEACHING PRACTICES: AN APPROACH THAT PROMOTES DEVELOPMENT OF REFLEXIVITY CASE OF PHYSICS-CHEMISTRY TEACHERS

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Abstract- Training a reflective practitioner is one of the challenges of teacher training programs around the world. This study conducted by a team of researchers composed of trainers, teachers and educational inspectors, aims to propose a training program for reflective practice related to the planning phase of lessons. Indeed, a program was designed, tested and validated with a sample of Moroccan physical science teachers. The evaluation of the effect of the said program on the teaching practices before the implementation of the lesson, was carried out via a grid whose criteria and indicators come respectively from the stages of the cycle of Kolb and the reflexive processes proposed by the model of Derobertmasure and his collaborators. The results are interesting and validate the interest of the collaborative work between the teachers in the development of reflective practice and the effectiveness of the training program.

Keywords: Reflexivity, Reflective Practitioner, Analysis of Practices, Pre-Analysis.

1. INTRODUCTION

The teaching profession is increasingly becoming a complex and changing function [1], yet the professional is invited to confront this complexity in order to adapt to this changing context. Faced with this observation, the curricula of initial and in-service teacher training should be designed in a context of paradigm shift from the applications model where the practitioner is a technician who applies and executes tasks to the professional reflective practitioner model [2], where the practitioner is able to solve practical problems, invent solutions and innovative tools for his teaching practice and improve continuously, analyzing his practice, confronting practice with theory [3].

Indeed, in the context of a global reform trend, initial and in-service teacher training is part of a dynamic of professionalization of the profession [4], but this process

is a slow and long transformation, however it can be provoked and promoted by a practice of reflective analysis [4]. This capacity for analysis is not intuitive or innate, especially at the beginning of the professional career [5], professional experience alone often does not produce learning [4], its profitability remains insufficient in relation to the improvement and adjustment of teaching practices [6]. As a result, and in order to bring a real change in teaching practice, it is necessary to aim for the development of a reflective identity guiding this change, based on a knowledge of analysis [7], by practicing, following an individual and/or collective reflective approach in a systematic, structured and equipped manner [6, 8 and 9].

Given the importance of the lesson planning phase as a framework and guide for action and in the continuity of our research project initiated by the analysis of the training program for future Moroccan teachers in relation to reflective analysis [10], we propose in this work a pre-analysis approach equipped with grids to support the development of a reflective posture among teachers. The objective is to help teachers become aware of their practice during the planning phase of their lessons and to analyze it so that they can self-regulate and guide their teaching practice for a more thoughtful implementation. With this in mind, we ask the following question: To what extent will this proposed approach be effective in improving the teaching practice of Moroccan teachers of physical sciences and chemistry?

Our general hypothesis is that the use of the proposed reflective program has positive effects on the improvement of teaching practices.

2. CONCEPTUAL FRAMEWORK

In teacher education, reflexivity seems to be a necessary condition for professionalization and is considered a cross-cutting component of professional competencies [11], or a key competence promoting the

development of these competencies [12]. The introduction of the concept "reflexivity" was introduced in the field of professional training thanks to Schon [13] in a context of extension of Dewey's philosophical work [14].

2.1. What is Reflexivity?

The concept of reflexivity is a polysemous concept, reflective practice, reflexivity, reflective analysis, critical thinking, are all terms that refer to reflection on and in action [15]. This lexical diversity leads to several models, due to the complexity of defining, operationalizing and evaluating it [16]. In this work, we are interested in reflexivity as a process of thinking and that can influence the teacher's pedagogical action and be influenced by that action. Thus, we adopt the following definition: "Reflexivity is understood as a posture favorable to questioning, helping to understand changes or to adapt to them. Facilitated by a third party (people, reading grids), it implies a mentalization of professional situations and leads the practitioner to look at himself acting in a position of exteriority, to distance himself from the situations experienced, and to analyze the over-determinations that structure his relationship to his practice and to the actors involved." [17].

2.2. What is a Reflective Practitioner?

A reflective practitioner presents an identity [7] that constantly reflects on the effectiveness of his or her pedagogical action before, during and after [9], his or her beliefs, prejudices, interests [20], the quality of teaching and learning, seeking alone and/or with others to solve practical problems innovate pedagogically [21], develop new ways of acting [22] and/or regulate old ones, develop analytical and meta-analytical skills by linking experience and theory [9], by referring to source persons/ coaches and/or reflective programs [23].

2.3. How to Foster the Emergence of Reflexivity?

All practitioners reflect on their practice, but this reflection does not necessarily lead to learning [18]. In order to make their practice a source of transformation and learning, practitioners are invited to redefine their professional identity, to form a reflective habitus [ξ], a training in theory-practice alternation based on a curricular project, allows to create the link and the meaning between the different elements of the training [2], specifies Perrenoud [19] «the clinical approach of training is nothing else than the setting up of situations which allow to learn by reflecting on the experience», supported by reflexive programs and a formative accompaniment [6].

2.4. Assessing Reflexivity

In the literature, various models exist that can be distinguished by the scales, levels and thresholds of reflexivity adopted [24]. If we consider Kolb's model (1984), it describes a learning process based on experience, direct action and reflexivity as a source of professional development [3]. It is a four-stage cycle (Fig 1). The first stage concerns the practical experience and interventions made by the teacher, the second stage invites

to put this practice as an object of reflexive analysis, the third stage concerns the generalization of good practices, confronting them with theory, in order to create personal models [18] and finally the fourth stage concerns the transfer of personal models in new situations in order to experiment it.

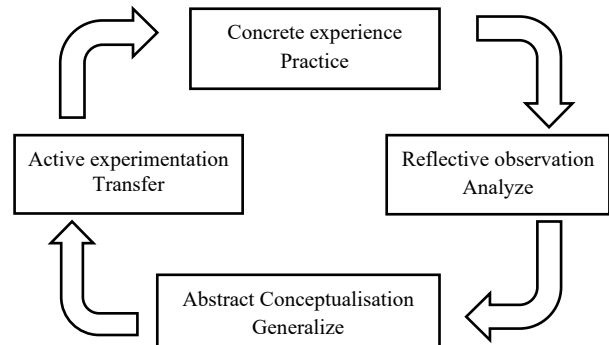


Figure 1. Experiential learning model [18]

The model proposed by Derobertmasure [25] results from articulation and synthesis of several models. It defines 3 levels of reflexivity covering 13 reflexive processes:

- The first level: The goal is to report...!!! [26], to shed light on what is deemed important in teaching practice.
- The second level: The teacher reflexively takes a distance from his or her teaching practice, legitimizing his or her practice according to a frame of reference, Internationalize and evaluate his or her practice [26].
- The third level: The teacher exploits the results of the reflective analysis and the alternatives proposed individually and/or collectively in a perspective of transferring these results into a new experience in order to experiment and validate them [26].

The reflexive processes related to each level are recorded in the Table 1.

Table 1. Reflexive processes [25]

Reflexive processes	Levels
Narrate/ describe	1
Questioning	
To become aware	
Point out difficulties / problems	2
Legitimize one's practice according to a preference, a tradition	
Evaluate your practice	
Internationalize your practice	
Legitimize according to pedagogical or ethical arguments	
Legitimize according to contextual arguments	3
Diagnose	
Propose one or more alternatives to its practice	
Explore one or more alternatives to one's practice	
Theorize	

3. RESEARCH METHODOLOGY

The work of this research was organized in three phases. The first phase was devoted to the design of a training program on the reflective analysis of the planning practices of a physical science course. The design team is made up of a trainer, a researcher and pedagogical inspectors. The second phase was dedicated to the validation of the program by a sample of experienced teachers and the third phase to its experimentation with a sample of teachers.

3.1. Design Phase of the Training Program

The training program includes a theoretical contribution on reflective analysis in general and on the analysis of teaching practices in relation to the lesson planning stage in particular, a pre-analysis grid, a guide for the use of the said grid and finally a reflexivity evaluation grid.

The elaboration of the pre-analysis grid was preceded by the analysis of the Moroccan programs and pedagogical orientations related to the teaching and learning of physics and chemistry in secondary school as well as the reference framework of the national exam and the teacher's guide "étincelle physique-chimie". The objective was to identify the determinants and foundations guiding the planning of learning in physical sciences, a key step in the development of our training program and its validation. Then, we developed a pre-analysis grid composed of three parts. The first one is called "Planning elements" and concerns indicators related to the targeted competence, learning objectives, prerequisites, teaching programs, duration allocated to teaching-learning and evaluation, concept extensions, interdisciplinarity, and experimental activity sheets. The second part is called "Planned teaching-learning progress" and the third part is about evaluation and remediation activities.

The theoretical contribution aimed at raising awareness of the interest of reflective analysis and its appropriation by teachers was made from a PowerPoint presentation and the discussion and exchange on a dialogue between an experienced teacher and a beginning teacher. This last tool aims to show the usefulness, the objectives and the instruments of reflexivity while taking into account the socio-professional context. Regarding the evaluation of reflexivity, we developed a grid (Tab 3) combining Kolb's model [27] and Derobertmeasure model [25].

3.2. Validation Phase of the Training Program

The program is designed collaboratively by a multidisciplinary team composed of researchers, didactic trainers and pedagogical inspectors of physics-chemistry. It has been tested and validated in two stages. It was subject to a pre-test with ten volunteer teachers, then tested and validated by eighty-six teachers who participated in the study, which led to several adjustments and modifications.

3.3. Experimentation of the Program

Data was collected from eighty-six physics-chemistry teachers in the junior high and high school cycles. The teachers first received theoretical training on the theme of reflexivity and then participated in a small group workshop whose objective was to analyze and discuss the dialogue between two teachers in order to identify and manage the participants' representations of reflective analysis. Then, each of the teachers proceeded individually to the reflective analysis of the preparation phase of his or her course, in particular his or her pedagogical sheet, and then a collective analysis of the preparations was conducted.

In order to evaluate the ability of the subjects to use the results of the reflective analysis and the alternatives proposed individually and collectively in a new planning, each one was asked to plan a new lesson. This corresponds to the active experimentation stage of Kolb's cycle and to the 3rd level as described by Derobertmeasure, et al.

In the evaluation phase of the program, we based ourselves first of all on the evaluation grid designed for this purpose, which allows us to describe the observed teaching practices and the underlying processes. These practices are expressed quantitatively and each element of planning, teaching-learning progress and evaluation-remediation is numerically coded in order to calculate the average and standard deviation at each evaluation stage. Next, the initial state (concrete experience) of the teaching practices was compared with the final state (active experience), in order to study the correlation between these two states. This comparison is made using a non-parametric statistical test. The choice of the test is justified by the normality result of the data obtained. The evaluation grid used includes four criteria from the Kolb model and the indicators for each criterion are from the Derobertmeasure model.

The statistical processing of the data was done using XLSTAT 2022, a statistical data analysis, visualization and modeling software. In order to guide our data analysis and to test our basic hypothesis, we formulate the following sub-hypotheses:

- H_0 : there is no significant difference between the concrete experience and the active experience in planning teaching-learning
- H_1 : there is a significant difference between concrete experience and active experience in planning teaching-learning
- H'_0 : there is no significant difference between concrete experience and active experience in teaching-learning progress
- H'_1 : there is a significant difference between concrete experience and active experience in learning teaching-learning progress
- H''_0 : there is no significant difference between concrete experience and active experience in learning evaluation-remediation
- H''_1 : there is a significant difference between concrete experience and active experience in learning evaluation-remediation

4. RESULTS AND DISCUSSION

4.1. Description of the Sample

We present in the Table 2 some socio-professional information of the population, subjects of the experimentation.

4.2. Description of practices

In the Table 3, we present the results of the analysis of the pre-analysis grids and the analysis of the new preparation forms elaborated after the training and which

correspond to the stage of transferring the acquired knowledge into a new experience (active experience). The results are expressed as an average. It is the average of the practices in each part of the preparation in relation to the number of teachers. The calculation of the standard deviation makes it possible to evaluate the dispersion of these practices around the calculated average.

Table 2. Socio-professional data of the study population

Factors		Number	Percentage
Sex	Man	54	63%
	Woman	32	37%
Teaching cycle	College	41	48%
	High school	45	52%
Professional experience	Less than 5 years old	17	20%
	From 5 to 10 years	22	26%
	From 10 to 20 years	27	31%
	More than 20 years	20	23%

Table 3. The reflexivity evaluation grid and its effects on teaching practice

Criteria and indicators of reflexivity		Units of coded written trace					
		Planning elements		Learning progress		Evaluation and remediation	
		Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
Concrete experience	Narrate	9.16	2.38	1.21	1.04	0.52	0.72
	Describe	9.16	2.38	1.21	1.04	0.52	0.72
Reflective observation	Legitimize one's practice according to a preference	16	0	4	0	4	0
	Evaluate one's practice individually, pointing out difficulties and strengths	16	0	4	0	4	0
	Individually internationalize one's practice by understanding one's role	0.74	0.82	0.90	0.62	0.52	0.72
	Collectively internationalize one's practice, confronting the individual results of analysis	2.95	0.80	3.25	0.43	3.37	0.48
Abstract Conceptualization	Individually propose one or more alternatives to one's practice	6.66	2.24	2.77	1.05	3.47	0.72
	Propose collectively one or more alternatives to one's practice	10.27	1.28	3.64	0.56	3.86	0.35
Active experimentation	Explore one or more alternatives to one's practice	12.93	2.03	3.31	0.46	2.43	0.63
	Theorize	12.93	2.03	3.31	0.46	2.43	0.63

In order to describe the results of the Table 3, an analysis is made by each of the criteria:

➤ **Concrete Experience:** This presents the initial state of teacher practices related to planning. Out of 16 practices related to the elements of planning, we find an average of 9.16 practices and a standard deviation of 2.38. The practices of 86 teachers analyzed seem to be moderately dispersed around the average, concerning the results of the analysis of the planned learning progress, we find an average value of 1.21 practices out of 4 and a standard deviation of 1.04. In this case, the dispersion seems low. The same is true for the evaluation-remediation activities since the standard deviation is 0.72. However, on 4 practices, we find an average of 0.52 practices.

Five key elements of planning are totally absent in the teachers' preparations. This is more pronounced for teachers with more seniority. This could be explained by the fact that the beginning teachers are freshly graduated from the training centers for future teachers and have benefited from the learning planning module and/or by the fact that the older teachers have lost reflex to develop their pedagogical records and rely on their field experiences.

➤ **Reflective Observation:** In this stage of Kolb's cycle, teachers work individually at first and then in small groups and then collectively. They are asked to explicitly internationalize the elements reported as strengths while determining their role in lesson preparation. The calculation of the average for the planning elements gives 0.74 practices, the standard deviation is 0.82. For the learning progress, the calculated average is 0.90 practices, the standard deviation is 0.62, while the evaluation-remediation the average is 0.52 practices and the standard deviation is 0.72. These results seem to show that teachers

are unable to make explicit the role of the majority of the elements present in their preparations and the internationalized practices are weakly dispersed around the calculated average.

The results of the small group and collective work inviting the teachers to internationalize their declared and non-declared teaching practices as well as their roles in the preparation of the lesson show that the average for the planning elements is 2.95 practices and a standard deviation of 0.80. For the learning progress, the average is 3.25 practices and the standard deviation 0.43, while for the planned evaluation-remediation practices, the average is 3.37 practices and the standard deviation 0.48. These results seem satisfactory and are in favor of an interesting evolution of the teachers practices who, after the collective work to internationalize more teaching practices and that these practices become less dispersed.

➤ **Abstract Conceptualization:** The results of this stage where the teachers are first solicited, individually, to propose alternatives of development of good practices and regulation and/or change of what could be considered as bad practices, the average relative to the elements of the planning of learning is 6.66 regulated, improved and /or proposed practices and the standard deviation is 2.24. These results show that these new planning practices are moderately dispersed. Concerning the planning practices of learning progress, average is 2.77 regulated, improved and /or proposed practices and the standard deviation is 1.05. This is in favor of a medium dispersion, whereas the planning practices of the learning evaluation-remediation activities present a low dispersion. We note an average of 3.47 practices regulated, improved and/or proposed.

For the collective work, the calculation of the average relative to the elements of the planning of learning gives a value of 10.27 practices, a gain compared to the individual work of 3.61 practices and a standard deviation of 1.28 and which decreased by 0.96. Concerning the practices of learning progress, the calculated average is 3.64 practices, a gain compared to the individual work of 0.87 practices and a standard deviation of 0.56 decreased by 0.49 compared to the individual work. The results relating to the planning of learning evaluation-remediation activities give an average of 3.86 practices and therefore a gain of 0.39 compared to individual work and a variation of the standard deviation from 0.72 to 0.35. All these results show less dispersed practices and seem to highlight the importance of the social dimension and collaborative work in the reflective analysis of teaching practices.

➤ Active Experimentation: the results of the analysis of the new forms prepared by the teachers give an average of 12.93 new practices regulated, improved or proposed in relation to the elements of the planning of learning and a standard deviation of 2.03, which is in favor of an average dispersion of practices. Concerning the planned learning progress practices, the calculation of the average gives 3.31 new practices regulated, improved or proposed and a standard deviation of 0.46, which reflects a low level of dispersion of practices. The results relating to the planning of evaluation-remediation activities show an average of 2.43 new, improved or proposed practices and a standard deviation of 0.63, which reflects poorly dispersed practices.

4.3. Evaluation of the Program

4.3.1. Study of Normality of Data: Shapiro-Wilk Test

In order to determine the appropriate statistical test to verify our sub-hypotheses, we must first study the normality of the data obtained. This study is done with the XLSTAT software, and allows us to verify this normality by six tests, the Shapiro-Wilk test, the Anderson-Darling test, the Lilliefors test, the Jarque-Bera test, the P-P graphical method, the Q-Q graphical method. In our case, all the tests agree on the same result. We present in the Tables 4-6, the result of the Shapiro-Wilk test, based on the following assumptions:

- H_0 : The variable from which the sample comes follows a normal distribution.
- H_1 : The variable from which the sample comes does not follow a normal distribution.

❖ Elements of planning for learning:

Table 4. Result of the Shapiro-Wilk test of planning of learning

<i>W</i>	0.847
<i>p</i> -value (bilateral)	<0.0001
<i>alpha</i>	0.05

❖ Learning progress:

Table 5. Result of the Shapiro-Wilk test of learning progress

<i>W</i>	0.847
<i>p</i> -value (bilateral)	<0.0001
<i>alpha</i>	0.05

❖ Evaluation and remediation of learning:

Table 6. Result of the Shapiro-Wilk test of evaluation and remediation

<i>W</i>	0.847
<i>p</i> -value (bilateral)	<0.0001
<i>alpha</i>	0.05

Interpretation of the tests: given that the *p*-value calculated in the three cases is lower than the significance level *alpha*=0.05, we must reject the null hypothesis H_0 , and retain the alternative hypothesis H_1 , which means that the data in planning, learning progress and evaluation-remediation do not follow a normal distribution.

4.3.2. Testing the Research Hypotheses: Wilcoxon Signed Ranks Test

To verify our research hypotheses, based on the non-normality of the data, we used the Wilcoxon test. We present the results of this test in Tables 7-9.

❖ Elements of planning for learning:

Table 7. Result of the Wilcoxon signed ranks test of planning of learning

<i>V</i>	0
<i>V</i> (normalized)	-8.126
Expected value	1870.500
Variance (<i>V</i>)	52986.375
<i>p</i> -value (bilateral)	<0.0001
<i>alpha</i>	0.05

❖ Learning progress:

Table 8. Result of the Wilcoxon signed ranks test of learning progress

<i>V</i>	0
<i>V</i> (normalized)	-8.204
Expected value	1870.500
Variance (<i>V</i>)	51989.625
<i>p</i> -value (bilateral)	<0.0001
<i>alpha</i>	0.05

❖ Evaluation and remediation of learning:

Table 9. Wilcoxon signed ranks test result of evaluation-remediation

<i>V</i>	0
<i>V</i> (normalized)	-8.709
Expected value	1870.500
Variance (<i>V</i>)	46130.250
<i>p</i> -value (bilateral)	<0.0001
<i>alpha</i>	0.05

Since the *p*-value calculated in all three cases is below the *alpha*=0.05 significance level, we must:

- Reject the null hypothesis H_0 , and retain the alternative hypothesis H_1 , with a risk of error $p=0.0001 < 0.05$.
- Reject the null hypothesis H_0 , and retain the alternative hypothesis H_1 , with a risk of error $p=0.0001 < 0.05$.
- Reject the null hypothesis H_0 , and retain the alternative hypothesis H_1 , with a risk of error $p=0.0001 < 0.05$.

From this perspective, it is concluded that the use of the proposed training program has positive effects on the improvement of teaching practices. To detail this point and measure the gain, we present in tables 10, 11 and 12, the difference between the concrete experience and the active experience:

❖ Elements of planning for learning:

Table 10. Comparison results between the concrete experience and the active experience in terms of the average and standard deviation of planning

	Concrete experience	Active experience	Variation
Average	9.16	12.93	3.77
Standard deviation	2.38	2.03	0.35

For the teaching practices in planning of learning, there was a gain of 3.77 units for the average and a difference of 0.35 for the standard deviation, which means that the practices become relatively less dispersed.

❖ Learning progress:

Table 11. Results of the comparison between the concrete experience and the active experience in terms of the average and standard deviation of learning progress

	Concrete experience	Active experience	Variation
Average	1.21	3.31	2.10
Standard deviation	1.04	0.46	0.58

For the teaching practices related to the learning progress, a gain of 2.1 units was recorded for the average and a difference of 0.58 for the standard deviation, which means that the practices become less dispersed.

❖ Evaluation and remediation of learning:

Table 12. Results of the comparison between the concrete experience and the active experience in terms of the average and standard deviation of evaluation and remediation

	Concrete experience	Active experience	Variation
Average	0.52	2.43	1.91
Standard deviation	0.72	0.63	0.09

For the teaching practices in evaluation-remediation of learning, a gain of 1.91 units was recorded for the average and a difference of 0.09 for the standard deviation, which means that the practices become less scattered.

5. CONCLUSION

The work carried out in this research aims at setting up a training program for teachers in reflective practice and the proposal of a reflexivity evaluation grid. The said training program is composed, on the one hand, of a theoretical contribution on the reflective practice, its contributions to the development of the professionalization of the teacher's profession and the evolution of its practices and, on the other hand, of analysis tools and guide. The analysis tools concern the analysis of practices related to course planning and cover aspects noted as "planning elements" such as competence and targeted objectives and aspects related to the learning progress and evaluation-remediation of learning activities.

The results of this research showed the effectiveness of the proposed training program in improving teaching practices related to course planning and that this positive evolution was not only due to individual reflective work but also to collective work organized and supervised by the research team.

The development of a reflective posture requires training, coaching and the development of a collaborative work culture. At the level of initial teacher training, we recommend that reflective analysis be integrated into all modules, especially since in Morocco, planning, learning progress and evaluation-remediation are taught in separate modules. This reflective dimension should also be taken into account in the planning stage of learning, as the emphasis is often placed on the "during" or "in action" and sometimes on the "on action". The development of a reflective culture of teaching practices also requires the effective integration of the analysis of practices at the level of alternating training between the training center and the schools. To this end, the center's trainers and the supervisors of the practicum should coordinate and use the sessions dedicated to the preparation of the practicum and to the regulation and not neglect the pre-analysis since the planning of learning is a key step in the teaching-learning process. Concerning practicing teachers, this study has shown the urgent need and the usefulness of their training, on the one hand, on the analysis of practices in general and reflective analysis in particular and, on the other hand, on collaborative work. Thus, these dimensions should be integrated into continuing education.

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