PEDAGOGY OF FORMATIVE ASSESSMENT: A MEXICAN EXEMPLAR

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ABSTRACT

Practitioner research is now widely used in different programs of teacher preparation. It is expected that teachers conducting research on their own work will become more reflective and develop the skills required to become life-long learners. Even though many programs for teacher preparation include some form of teacher research it is not common to find tools to assess teachers and to allow for peer- and self-assessment. In this chapter, we present a pedagogy that uses heuristic diagrams as a mean to assess teachers' research. We have used such heuristics with teachers participating in a Research Methods Course in a Master Degree and have found that it allows teachers to engage in a constant interplay between the theoretical and the practical and encourages the development of better research questions. Teachers have systematically found this tool very useful in advancing their research projects in the different scenarios where teachers are trying to improve their practice through research.

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INTRODUCTION

Assessing teachers is a daunting task. Teachers' knowledge is so multifaceted and complex that any attempt to capture it through any set of instruments seems always incomplete. Despite all that has been written and researched on different approaches to teachers' professional development, accounts of assessment as a mean of supporting teachers' development is rare. In this chapter, we briefly describe traditional teachers' assessment and then introduce the approach of *teacher as researcher* as a privileged format for beginning teacher preparation. We present a heuristic tool that has been used to formatively assess prospective teachers' performance in their research. Finally, we offer some results of the use of this tool with science teachers in Mexico, trying to convey the specific contexts and situations in which it has been deployed and the results obtained. We hope teacher educators will find our pedagogy of assessment useful in their work with prospective teachers and adapt to their particular teacher education settings.

THE PROBLEM OF TEACHER ASSESSMENT

Teachers' assessment is a practice that can be traced back to more than a century in different parts of the world. Shulman (1986) recognized that as early as 1875 there were governmental bodies whose responsibility was creating tests that could identify who could be a teacher. Most of these tests items were related to subject matter knowledge; very few items addressed pedagogical knowledge. In countries like Mexico, teachers' assessment is a more recent phenomenon and some researchers (Cordero Arroyo, Luna Serrano, & Patiño Alonso, 2013) locate its institutionalization in the 1970s.

Every country has its own means to assess and certify teachers. However, there are some common elements that relate mainly to the relevance of subject matter knowledge and to teachers' performance: what teachers should do in the classroom, and how and when they should do it. These kinds of assessments are top-down and do not consider the settings

in which teachers' practices unfold. Therefore, we cannot expect that these assessments can bring about changes in teachers' practice.

On the other hand, Hattie (2009) has found in a large study relating the influences on school-aged student achievement that one of the most important factors on student success is feedback. Hattie explains:

> When teachers seek, or at least are open to, feedback from students as to what students know, what they understand, where they make errors, when they have misconceptions, when they are not engaged-then teaching and learning can be synchronized and powerful. Feedback to teachers make learning visible … feedback information is provided by an agent (e.g. teacher, peer, book, parent, or one's own experience) about aspects of one's performance or understanding … feedback is a consequence of performance … . (Hattie, 2009, p. 173)

As suggested earlier, a different kind of assessment that relies on feedback and that is derived from teachers doing practitioner research could be implemented. We will develop such pedagogy in the rest of the chapter.

PRACTITIONER RESEARCH AS PROFESSIONAL DEVELOPMENT

According to Ball and Forzani (2009), teaching is one of the most common and one of the most difficult human activities. When teachers have been at school for many years they may lose sight of this inherent difficulty, and teaching becomes something *natural* (Reid, 2011). Participating in practitioner research demands teachers to study their practices and to consider the practice of teaching as something strange that needs to be planned, executed, and assessed. In this orientation, teacher-students need to assess themselves and also be assessed by others who accompany them in this endeavor (teacher educators and peers). Teacher research has been found valuable because it is expected that teachers are knowledgeable not only about content and pedagogy but also about different ways in which they can reflect on their own work of becoming life-long learners (Darling-Hammond & Bransford, 2005).

Much has been written about the incorporation of teacher research as an integral part of many programs of professional development. Teachers' research can be identified by other names such as action research, self-study, narrative inquiry, or practitioner inquiry, and could be related to different approaches to inquiry ranging from those more related to the world of professional researchers, and centered in theory to those more akin to

the world of teachers and closer to actual practice (Reis-Jorge, 2007). Teacher research or practitioner research has been regarded as a fruitful way to develop teacher knowledge and improve teachers' practice (Altrichter, Feldman, Posch, & Somekh, 2008; Cochran-Smith & Lytle, 2009; Loughran, Mulhall, & Berry, 2004).

Practitioner research assumes that professional expertise comes in great part from the teaching profession itself. Teachers generate knowledge when they treat their classrooms as sites for intentional investigation and use theories and knowledge produced by others as material to interrogate and interpret their own practice (Cochran-Smith & Lytle, 2009). Practitioner research also clearly helps developing teachers' Pedagogical Content Knowledge (PCK) (Shulman, 1986) since teachers have to connect what they know about science, for example, with the best ways to teach it. It motivates them to look for analogies, examples, and diverse ways to help students develop scientific knowledge. Teacher research is a space for reflection.

Although many attempts have been undertaken to describe effective professional development programs based on teacher research, there is little empirical research on their outcomes (Grossman, Hammerness, & McDonald, 2009). Also, assessing quality in such research is not an easy or straightforward task (Capobianco & Feldman, 2006). Second-order inquiry into inquiry has revealed some components that seem to be indispensable for successful teacher research. Amongst those, Capobianco and Feldman (2006) identify that it should develop a collaborative community of practice. Moreover, Cochran-Smith, Barnatt, Friedman, and Pine (2009) recognize that clarifying the conceptual underpinnings of one's own research is a relevant characteristic of fruitful inquiry because it makes students relate their particular teaching approaches with larger reflections on students as learners.

The heuristic diagram (HD) that we present in Table 1 is a tool that allows teachers performing research to consider how the theoretical illuminates the practical and how the practical allows for a new (more nuanced) interpretation of theory.

HEURISTIC DIAGRAMS AS A PEDAGOGY OF FORMATIVE ASSESSMENT

HDs are graphic organizers and an improvement of Gowin's Vee (Novak & Gowin, 1984). Graphic organizers represent thinking processes;

Table 1. HD Derived from the Research of One Teacher-Student.

Title: Heuristic Diagram about teaching chemical reaction		Points
Facts: 1. Students are not binding macroscopic, microscopic and symbolic representation levels (1). 2. Students consider that in a chemical reaction, a substance changes its appearance, but retains its identity, *i.e.* remains the same substance (2).		3
Question: How do I facilitate students to link the levels of representation on the subject of chemical reaction?		2
Concepts	Methodology	Points
Applications: – *Scientific*: Synthesis of new substances and development of new materials. – *Pedagogical*: The chemical reaction is the core of chemistry, as it is one of the main objects of study of this discipline.	*Data collection*: For data collection a pre-test and post-test was conducted. In addition, students were asked to answer worksheets for each activity that was part of the teaching proposal (4).	2 1
Language: – *Scientific*: chemical species, molecular entities, microscopic chemical events (3). – *Pedagogical*: Pre-test, post-test	*Data processing*:A question that asked students to give an explanation for a phenomenon was analyzed. Then the results of the pre-test and post-test, respectively, were shown. Two white, A and B substances are contacted and after some time the appearance of a yellow color was observed.	1 1

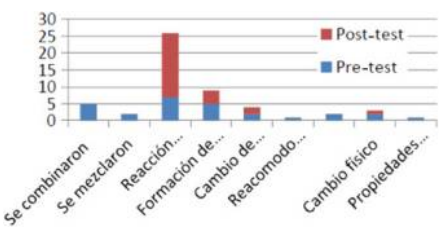

Table 1. (*Continued*)

Concepts	Methodology	Points
Models: With cognitive model (5) it is expected that students move towards increasingly complex cognitive skills, either by themselves or with the help of the teacher.	*Conclusion*: 73% of the students mentioned that it was a chemical reaction.	3 2
Answer: According to the cognitive model used, the activities carried out indicate that students improved their understanding of the concept of chemical reaction, and in some cases, provide arguments related to the microscopic level of representation.		2
References: *Facts*: (1) Casado and Raviolo (2005), (2) Raviolo, Garritz, and Sosa (2011). *Concepts*: (3) Petrucci (2011). *Methodology*: (4) Méheut and Psillos (2004), (5) Monroy (2006).		3
Self-assessment (total points)/24 possible points		20/24

they can be regarded as a "cartography of cognition" that makes learning visible (Trowbridge & Wandersee, 1998; Wandersee, 1990). Gowin recognized the initial difficulty of students in producing Vees, particularly the time required to become competent, but he also recognized its value. This tool has been proved as useful in different ways, including formative assessment (Calais, 2009; Gowin & Alvarez, 2005). Its main feature is the possibility it entails for relating conceptual frameworks, research questions, and research outcomes (Doran, Chan, Tamir, & Lenhardt, 2002).

The heuristic Vee is composed of five parts: (1) events or phenomena to be researched, (2) the research question, (3) a methodological part, (4) a conceptual part, and (5) the answer to the research question. One of the main features of the heuristic Vee is that it explicitly relates the conceptual-theoretical aspects of a research question with the practical aspects, allowing for a constant interplay.

HDs incorporate Toulmin's philosophical approach (Chamizo, 2007). Toulmin's work (1972) recognizes the complexity inherent to concepts through its historical–social interactions. Like Vee diagrams, HDs can be used as a pedagogical tool to develop research (in teaching history – Chamizo, 2012; or in laboratory assessment – Chamizo & Colsa, 2009; or as a tool to assess teacher's research – Chamizo & García-Franco, 2013; or to facilitate the acquisition of argumentative competence – Pérez-Campillo & Chamizo, 2013) because it helps identify all the elements of the investigation, recognized in the Problem-Based Learning approach (Chamizo & Izquierdo, 2007). Concerning this "dialectical circle," in which one starts with a question and both the concepts and the methodologies become "visible," Trowbridge and Wandersee (1998) explained:

> You focus on the research (or focus) question and decide what is that you want to study elaborating the methodological side. Next, you develop the theoretical side and you will be able to see how theory (concepts) affects and modifies practice. Once the research is done you will be able to see even more how practice affects theory and vice versa. (Trowbridge & Wandersee, 1998, p. 115)

One of the main improvements of HD is that it brings more clarity to the conceptual part of the heuristic Vee. The HD recognizes that each concept requires three different aspects for its complete understanding: applications, language, and representation techniques. In other words, it means models (Chamizo, 2013). Reflection on these different aspects allows for a more thorough comprehension of the conceptual elements that are relevant to any given investigation.

Furthermore, the HD considers two dimensions for concepts: scientific and pedagogical. So, for example, if teachers were to develop a didactic intervention or pedagogy to teach "chemical bonding," they should recognize what chemical bonding is, how it is represented (i.e., choose among the different chemical bond models', the one that will be used in the didactic intervention or pedagogy) and why it is important, but they should also acknowledge the theoretical framework that supports their teaching approach (i.e., identifying their applications, the language used, and the model that is sustained). By including the pedagogical and scientific framework, teachers can develop their pedagogical content knowledge which is highly relevant in improving practice (Garritz & Trinidad, 2004; Loughran et al., 2004). As we have stated elsewhere (Chamizo & García-Franco, 2013), one of the main advantages of the HD pedagogy is the relevance of the conceptual framework for teacher research.

HDS AS TOOLS FOR ASSESSMENT

Assessing teacher knowledge implies considering teachers as a "complex, organic agency" (Schwab, 1969). Therefore, no measure can be applied and we have to look for ways of assessing teachers' developing knowledge in ways that are pertinent and relevant to their own practice. Of course, there is no single theory that can consider all the different aspects involved in designing and implementing a teacher "intervention." The interrelations between subject matter, students' reactions, and school setting are far too complex. Therefore, teachers' assessment of their own work can provide a better look into practice and its relevance.

HDs allow for the interplay between what student-teachers, for example, think about teaching (designing a learning sequence) and what actually goes on when they enact the pedagogy. Somehow it motivates teachers-students to reflect on their beliefs and knowledge about what works in teaching because they are required to analyze what actually goes on in the classroom. It is not sufficient to have a sound research-based teaching sequence. Situations that occur in classrooms surprise prospective and practicing teachers and make them stop and look at what is actually going on. The use of heuristic tools such as the HD, when enacted in a supportive environment and incorporate feedback loops, can bring about actual change in preservice and in-service teachers' skills and conceptions (Black & Williams, 2009). It is also important to indicate that among the vast multitude of facts related to the topic, they have to choose only two or three facts and use them to write the proper question

in the HD. It is not an easy matter; however, it has been paid scant attention in the preparation of teachers.

Another important issue about HD is that the question may have an answer or a result, and pedagogical and cognitively, both are considered equally important and receive a similar score. Here, prospective and practicing teachers have to make a decision. A response to the question indicates certainty in the activity done. A result may indicate a failure or error from which, however, something can be learned. Here is how we share the ideas expressed by Reid (2011, p. 9) as cited in Atherton (2011):

> What the teacher does is decided upon "in reflection". This is an important and much-valued aspect of teacher education as a disciplinary enterprise at the present time, particularly in connection with Schön's (1983) notion of "the reflective practitioner" whose capacity to reflect on action and continuously learn from this "was one of the defining characteristics of professional practice." (Atherton, 2011)

We would expect that assessing teachers-students work using HDs would help them to consolidate inquiry as a stance (Cochran-Smith & Lytle, 2009) and would help the community of teacher-researchers to establish their own means of assessment.

The case we now present is framed in the context of a master's degree for professional preparation. Many students in this program have paid leave from their institutions so they are relieved from teaching duties and are able to focus full-time in the project. In this case, students are expected to complete a dissertation that is presented for an oral examination. This kind of teacher research has been identified by Reis-Jorge (2007) as closer to the world of teachers but also uses a theoretical approach because students are expected to develop enough theoretical understanding to be able to relate their research questions and chosen methodologies in a coherent way. Research such as this can have an impact in teachers developing high self-esteem for completing such a large task and in developing teachers' research skills which are useful when they need to help their own students develop their research skills. There is a downside to this kind of teacher research as well. It is the difficulty of adding teacher research to teachers' everyday contextual situations because they lack time and material resources to complete such a high demanding task. However, research on teacher research (or inquiry into inquiry) has revealed that research projects that seem to be more complete and result in larger teacher transformations are those that have explicit conceptual frameworks (Cochran-Smith et al., 2009).

DESCRIPTION OF AN INTERVENTION USING THE HD PEDAGOGY

We have systematically used the HD as a formative assessment tool in a 16-week Research Methods Course in a Master degree in the Universidad Nacional Autónoma de México (National Autonomous University of Mexico, UNAM). The course is delivered in the third of four semesters and is intended to be a space where teachers learn the basics of educational research and develop their research project. Along their degree, teachers are expected to develop a written dissertation (to be defended orally) as a result of research performed throughout the duration of their studies. This research addresses problems teachers have identified during their practice and teachers are expected to reflect on these problems through what they have been learning in the different courses. When teachers get to this particular course on Research Methods, it is likely that they have different degrees of advancement in their research project.

Mexican high and middle school teachers are not specifically trained to be teachers. They graduate in science, engineering, or related degrees and then they automatically become teachers if they so desire. This makes in-service professional development particularly necessary.

In this Research Methods course, teachers-students pursue a process of continuous iteration in developing their own research project. In total, three different HDs are constructed and self-assessed with an interval of 6 weeks apart. The rubric for self-assessment is constructed through a discussion with teachers-students with the aim of not only assessing the HD but also to serve as a guide for learning. Appendix of this chapter indicates the instructions to fill in the HD, taking into account that it should not occupy more than one page. The self-assessment rubric is also given. When students are not familiar with the HD time needs to be allotted to learning how to use it and reviewing examples from other teachers-students.

The study was conducted in every course. All diagrams were collected and students were interviewed at the end of the semester to find out how useful they thought the HD pedagogy was. Previous results of the outcomes of using this HD pedagogy have been reported elsewhere (Chamizo & García-Franco, 2013).

RELEVANT FINDINGS

In this short section we would like to highlight the main advantages of using the HD as an assessment tool for teachers. We use evidence

(HDs, answers to questionnaires, and interviews) obtained from different courses, some of which has been discussed previously in a different paper (Chamizo & García-Franco, 2013). Our aim is to show some of the most relevant aspects of the HD as an assessment tool.

HD pedagogy helps teachers-students to define and refine their research questions. Along the course, students refine the questions they are asking; through research and in-class discussion, teachers-students modify their initial questions to encompass their interests and consider methodological issues. This skill is deemed relevant for teachers because it helps them to construct the inquiry stance which can be used in the rest of their teaching life. It is expected that questions are structured with precision and clarity, are univocal (i.e., their meaning is the same for different subjects), and feasible (i.e., that can be answered in the particular research conditions). Since every time teachers turn in a HD there is time for feedback, not only from the teacher but also from peers it is possible to see questions developed throughout the course. Examples of progression of research questions of some of the teachers-students are shown in Table 2. The reiterative use of HD pedagogy helps teacher in developing such skill.

Table 2. Examples of Progression of Research Questions.

HD	Teacher-Student 1	Teacher-Student 2	Teacher-Student 3
First	How does gender promote the reduction of the difficulties of learning stoichiometry?	What is the students' attitude about nature of chemistry?	How does a multimodal interactive environment based on technological environments foster meaningful learning of stoichiometry in high school?
Second		What are the features of the nature of chemistry?	How will an interactive multimodal environment encourage learning stoichiometry in high school students?
Third	How do reported gender cognitive skills influence their learning of stoichiometry?	What characteristics of the nature of chemistry do chemistry freshman students recognize?	How will an interactive multimodal environment encourage learning stoichiometry in high school students?

Progression in questions, at least for teacher-students 1 and 2, coincided with the views expressed by Otero and Graesser (2001) in the sense:

> There is ample empirical evidence that students can be trained to ask good questions and that such training leads to significant gains in learning and literacy (…) We believe that a sophisticated understanding of question asking should strengthen this link between asking and learning. (p. 4)

Moreover in agreement with Chin and Osborne's (2008) question typologies, the third question of the three teacher-students is an open question (Chamizo & Hernández, 2000) supported with facts that include concepts and suggest some methodological considerations. These authors noted:

> The explicit teaching of question typologies is another way in which teachers can get students to pose questions. Teaching students' categories of question types can make them aware that different kinds of questions elicit different thinking processes that help build answers in different ways that can lead to insight. (Chamizo & Hernández, 2000, p. 29)

Chamizo and Hernández added:

> This review has demonstrated that students' questions can help students to monitor their own learning, explore and scaffold their ideas, steer thinking in certain specific directions, and advance their understanding of scientific concepts and phenomena. For teachers, these questions can be used as indicators of students' learning problems, and provide diagnostic information about what students are thinking. Students' questions can also be harnessed for lessons that involve class discussions, argumentation, investigations, problem-based learning, and project work. (Chamizo & Hernández, 2000, p. 34)

These progressions in HD help make learning visible. For example, one of the teacher-students indicated at the beginning only the topic of her research (separation of mixtures). In her second version her question became:

> Is learning chromatography improved by the articulation between theory and experiment when it is contextualized with stories of forensic science that foster inquiry?

It is possible to see how constructing HDs can aid teacher-students in becoming aware of the complexity involved in the research question and how they incorporate different aspects relevant to the problem. In the aforementioned question, the teacher incorporates pedagogical aspects (articulation between theory and experiment inquiry) as well as the specific context in which her research is carried out (stories of forensic science). Such clarity is very relevant to frame and reflect on her findings and to identify more elements pertinent to her analysis. Consistently, with the aid of the HD pedagogy, teachers develop more specific questions, and incorporate theoretical and methodological aspects, which is very relevant for their research project.

In Table 1 we present a completed HD. Readers can see how this particular teacher-student came to incorporate theoretical elements that were relevant in the analysis of students' outcomes. We underscore that one of the main advantages of the use of HD pedagogy is that it favors coherence in research projects because it demands a constant interplay between theoretical and practical features of the research question. In this case, the student could determine the main theoretical elements that were underpinning her research. Through the use of terms such as "cognitive model," "cognitive skills," she makes a clear connection between the theoretical framework and what her students are achieving. Distinguishing the three aspects of concepts in their scientific and pedagogical dimensions allows teachers to make the theoretical framework explicit in both dimensions. The reiterative use of the HD provides teachers-students with a tool to revise the conceptual framework and its relation to the actual results.

The use of the self-assessment rubric allowed for explicit recognition of different aspects relevant to the research process. It also aims to clarify each part of the HD and its relationship to the other parts. This allows for explicit recognition of progress toward an established standard. The teacher-author of this HD assessed her work with 14, 17, and 20 points in her successive HDs, which can be regarded as evidence of her own recognition of change resulting from the formative assessment tools and productive feedback in the interim.

Finally, we present some direct quotes from teachers that highlight the usefulness of the HD as a useful tool in the development of their research projects. Teachers were interviewed or answered an open-ended questionnaire regarding the usefulness and difficulties of having worked with the HD in the course. We have purposefully selected these quotes in order to illustrate some of the aspects we have been discussing. Some of these quotes have already been presented in a previous paper (Chamizo & García-Franco, 2013), but we have included them here to give a more complete account of teachers' perceptions.

Teachers find that the HD encourages a more consistent development of their research project. Particularly, they emphasize the relation between different aspects (theoretical, methodological, results) of the research, which is the main objective of using the HD in this course.

> In building a HD if you know the subject well, you have to synthesize information, choosing what is relevant to answer the question. On the other hand, if you do not know the subject well, the structure of HD forces you to analyze, understand and communicate the outcome of the investigation.

> It is very useful. At the end I realized how much it helped to restructure my work. I had not figured out [prior to developing the heuristic diagram] that my work was all over the place.
>
> It helped me focus the subject of my dissertation and find a model that helps me develop the teaching intervention.
>
> The heuristic diagram allowed me to delimit my research as I was developing it. The fact that it has different sections such as facts, questions, etc., allows the separation of the parts we want to research or solve and so we work in a more organized way.
>
> The most important thing of HD is its ability to integrate knowledge.
>
> I found the HD useful because it helped me to be specific in my thesis subject. In this sense it allowed me to refine my research and gave me a guide on how to continue developing my Project. Each category of HD was giving me information from which I could get an answer to my research question and give coherence to it.

One of the main strengths of the HD is the possibilities it offers to share and discuss the work with peers and instructors. Teachers take advantages of the possibilities of constantly reviewing it along the course. There has to be an environment that encourages and allows assessing and commenting each other's work (Capobianco & Feldman, 2006). Integrating self-assessment into the HD is also very important, not only because it is fundamental in developing practitioner research (Black & Williams, 2009), but because it also offers opportunities for reflection on the work that is being undertaken. Teachers seem to recognize these opportunities.

> Self-assessment makes sense if several HD are made along the course, allowing you to recognize your level of progress.
>
> Self-evaluation is not about knowledge is about the internal consistency of HD. Therefore it is important, because it helps to assemble the HD correctly.
>
> Also I would include a section to consider peer assessment of my colleagues to get more information about my level of progress.

Teachers have also identified some challenges in using the HD. From the following teachers' quotes it is evident that use of the HD to assess (and self-assess) practitioner research should be thoroughly discussed with participant teachers in order to be really useful. Also it is very important that assessment tools such as the HD are timely introduced to teachers.

> It is not necessarily difficult but such a predetermined structure needs for one to be convinced that it will be useful. Otherwise it is just seen as an imposition.

> It is useful, but I think it is too late to start (in my case until the third semester) it was a great help but we should start since the second or first semester because we have to start our project.
>
> It implied a whole new way of looking at things and I had previously developed a structure for my work.

FINAL THOUGHTS

Usually universities look at school teachers' generated knowledge with suspicion and deem it as not being scientific. The introduction of tools such as the ones described in this chapter provides a different meaning and recognizes the teacher as an agent. Teachers in learning communities need to develop their own means of assessment, and the time they spend reflecting on their own practices should be considered as part of their teaching schedules.

By using heuristical tools that encourage and enhance reflection, teacher-students form a community of practice and establish positive interactions by comparing teaching pedagogies using specific and shared criteria. Teachers and teachers' educators can then help each other in the task of understanding the outcomes of the teaching intervention and the possible explanations for things having turned out the way they did.

The HD pedagogy asks teachers and prospective teachers to make explicit the implicit and to recognize what is ignored in the research process. It results in a scaffolding of knowledge, which is a way to integrate theory and practice. Additionally, the use of a self-assessment rubric allows teacher-students to establish better relationships between the question and the answer through enhancing both conceptual and methodological parts. Hattie (2009) recently reported that students' estimates of their own performance is the single most important factor related to achievement.

We have presented the use of the HD pedagogy in a course where novice and more experienced teachers participated. Through the iterative development of the diagram, it was possible for teacher-students to recognize the complexities involved in teaching and to convert their classrooms into investigative spaces. Feedback from the professor in the course and from peers turned this HD pedagogy into a tool that can be used for teacher assessment in different spaces: whether in formal courses in universities or in preservice or in-service teacher research groups where the main feature is trying to understand practice in order to improve it. This pedagogy relies on teachers being interested in reflecting in their own practice and professors willing to accompany them, therefore it could be applied in any

country regardless of the different schemes of preservice or in-service preparation of their teachers. Certainly, it requires having time allocated to perform research in the classroom and time for feedback during the courses, as well as disposition to analyze ones' own practice and modify it, hence flexibility is to be expected if the pedagogy is to be successful.

Teachers' assessments should strive to assess curriculum in practice as it relates to "real things," specific teachers teaching specific content to specific students in a specific setting. As Schwab (1969) stated, the practical not only adds to the theoretical, but also modulates it. Such has been the case with our HD pedagogy.

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APPENDIX: INSTRUCTIONS FOR COMPLETING A HEURISTIC DIAGRAM AND SCORING RUBRIC

Title: (Refers to the subject of research)		Points
Facts: (This refers to information obtained and/or observations about something happening in the world that leads us to ask a question. Preferably should identify several of them)		
Question: (Statement of an inquiry focusing on the facts. We must make sure that there is only one question)		
Concepts	**Methodology**	0
Applications (Refers to applications for the issue under investigation)	*Data collection* (This refers to what we do to obtain the relevant information to answer the question. It should be pointed and detailed)	
Language (Refers to the terms we need to know to answer the questions)	*Data processing* (Refers to data management and results in tables, charts, diagrams, etc. which summarize the data obtained)	
Models (This refers to the model used to give the answer to the question. It may be scientific, economic, social, etc. For example, Lewis' atomic model, or Arrhenius' acid-base model, or market model, constructivist learning model, etc.)	*Conclusion* (This refers only to that obtained from the processed data)	
Answer or Result: (Refers to the explanation that answers the question by bringing together the concepts and methodology's conclusion) or in case that there is no answer the result of the research		
References: (This refers to books, magazine articles, websites, etc., consulted and used in every part of the investigation)		
Self-assessment (addition of all points) (You need to score all the points collected and compared against possible points)		