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Critical Exploration in the University Classroom: Implications for Teaching and Teachers

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Abstract

The paper introduces an educational approach developed by Eleanor R. Duckworth named Critical Exploration in the Classroom (section 1) and outlines the basic educational components central to this approach (section 2). After that selected finding so fan in-depth case study conducted in Professor Duckworth?s higher education classroom at Harvard Graduate School of Education in the United States will be presented. The empirical case study investigated how the learning environment in the classroom was designed to support deep exploratory learning exploring both, curriculum design and pedagogy (section 3). As a result, pedagogical implications on how educators can use their know-ledge to help students learn will be outlined (section 4).

Index terms— Critical Exploration, higher education, understanding, deep learning, teaching.

1 What is Critical Exploration in the Classroom?

ritical Explorationis an approach that challenges the traditional role of the teacher as one who imparts knowledge. Instead, it supports a move towards students' greater intellectual involvement by fostering student-centered learning processes in the classroom. As a progressive approach to learning and teaching, Critical Exploration puts learners and their understanding of the world center-stage. According to Piaget "to understand is to discover, or reconstruct by rediscovery;" therefore, certain conditions must be complied with "if in the future individuals are to be formed who are capable of production and creativity and not simply repetition" **??**1972, p. 20). **??**uckworth (1987 **??**uckworth (/2006, p. 1) , p. 1) considers the development of intelligence to be a creative affair and "the having of wonderful ideas" to be the essence of intellectual development. In order for these ideas to arise it is necessary that teachers are willing to listen to students' ideas and that they provide educational settings suggesting different ideas for different students so that each student can work on a challenging intellectual problem (ibid., p. 7). "Wonderful ideas" can only flourish in an educational environment where students can generate their own knowledge and where students and teachers are co-learners working alongside each other in the educational process.

BärbelInhelder first introduced the term "Critical Exploration" for Piaget's clinical interviewing method as she applied it to pedagogical contexts that included observing children as well as interviewing and interacting with children who were experimenting and investigating a problem set by the researcher. When applied in an educational context, Critical Exploration as a scientific method can have two levels of meaning, according to **??**uckworth (1987 **??**uckworth (/2006, p. 159, p. 159): (1) exploration of the subject matter by the student (instead of only words) and (2) exploration of the students' thoughts, i.e. striving to understand the meaning an experience holds for the student, by the teacher. As a pedagogical approach Critical Exploration supports a move toward students' greater intellectual involvement by considering the learner to be an active explorer building her own understanding while the teacher acts as a facilitator to assist the learners' inquiries. The teachers'

responsibility is to develop explorable curricula and to create a classroom environment where learners' thoughts generate the intellectual life of the classroom while the teacher provides some direction through environmental resource selection (assignments, materials), activities and genuine questions to further students' engagement. **??**uckworth (1987 **??**uckworth (/2006Duckworth (, 2009)) stresses the following two major aspects that are original about Critical Exploration as a pedagogical approach: I.

2 I know I cannot teach anyone anything,

I can only provide an environment in which he can learn. (C. Rogers)

a) The way teachers use their own subject matter knowledge, as curriculum planers and as teachers They plan how to engage students' minds in exploring the subject matter, put students in direct contact with the subject matter and keep them attending closely to the material. For example, the teacher thinks about what materials he will use, how he proposes to begin the session, different ways in which the session might develop, and what he might do in each case. He brings materials to the classroom that provide a source of feedback and against which the students can test their ideas.

b) The way educators focus on the students' thoughts rather than their own

The teacher invites students to express their thoughts/ideas to come to understand how students are seeing things. Critical Exploration in the Classroom constitutes a triangular, dynamic relation between three pedagogical elements: the represented challenge, the teacher, and the students. These three elements create a dynamic that offers the teacher a window into the ways in which different students go about making sense of the represented challenge. The didactic triangle represents the basic structure of the teaching and learning process and helps to analyze its main components and their relations (Figure 1).Moreover, this structure can help to think more about what teachers can do with their knowledge if they do not simply tell it to the students. Although the components will be tackled separately below they are interrelated and need to be closely aligned to allow for deep learning to take place. In order to learn, students should be given opportunities to be in contact with phenomena related to the area to be studied. A specific intellectual challenge is represented in concrete form (object), for example, a poem, a painting, a case in economics, materials embodying a problem in physics or mathematics. Thus, the students have something complex and authentic to look at and think about, instead of oversimplified, artificial materials or just spoken words. This way, they can connect with the phenomena and make sense out of it for themselves instead of being presented with the meaning somebody else is making. Duckworth argues: "[I]f you want to help kids and teachers learn about the material world, like batteries and bulbs, or pendulums, or earthworms, or butterflies, you give them batteries and bulbs, pendulums, earthworms, and butterflies. And you let them look at them, notice them, figure out their questions, and come to be familiar with these things. You don't give them words about these things, you give them these things. Now that's similar to the poem, too. You don't give them somebody else's words about a poem, you give them the poem." **??**Duckworth in Meek, 1991, p. 32) These concrete representations or objects can fulfill several educational functions: ? The subject matter itself instead of words allow students to act on material things so that they can discover the specifics of an object for themselves.

This way, they can make a connection to the world and assimilate new experiences in ways that make sense to them.

? Students have reliable materials at their hands that are the proving ground against which they can develop and assess their own ideas or upon which students and teachers can collaboratively assess each other's ideas and claims to develop shared understandings. This way, the subject matter is the source of authority -without the need for the teacher as intermediary.

? Getting to know each other's ideas and seeing each other's confusions can help students and teachers to understand as they might have similar confusions and ideas. However, sometimes students "see how each other's ideas pass right over their heads, and they can't connect with them. Then six weeks later they hear exactly the same idea; and they notice, well, now they can connect with it." (Duckworth in Meek, 1991, p. 31)

? Students are given opportunities to work on topics and projects that interest them and often construct their own objects. While working on something on their own, students come up with their own ideas as they make sense out of the phenomena. They also pass through confusions and feelings as they cannot make sense out of the phenomena yet. Finally, when they get their minds around their own puzzling questions and ideas and see that their ideas can work out and can be of interest to other people, they can expand their connection to the world and also develop feelings of self-confidence.

? Interesting materials and activities can engage students' minds by providing occasions where surprise, puzzlement, excitement, patience, caution, confusion, honest attempts and wrong outcomes are important elements of intellectual development **??**Duckworth, 1987 **??**Duckworth, /2006).

b) The Role of the Student in the Learning Process In Piaget's view, intellectual development is a process of equilibration where an individual interacts with the world based on two complementary processes: Assimilation means "the integration of external elements into evolving or completed structures." The process of II.

not to influence what students say as they are saying it. This way, teachers can use their insights to inform their teaching in terms of how next to call on their knowledge of the subject matter -what resources to provide, what next questions to ask to engage the students' minds continually with the subject matter and to broaden and deepen their understanding.

assimilation allows an individual to take external elements into previously constructed structures and thus, provides for continuity and sense-making in a person's cognitive development. Accommodation is "any modification of an assimilatory scheme or structure by the elements it assimilates" **??**Piaget, 1976, pp. 170 and 172). The process of accommodation is responsible for the transformation of already existing structures and thus, for further cognitive development. Through the intrinsic process of equilibration, which Piaget considers to be the motive for cognitive growth, a learner actively constructs structures throughout his life while acting upon the world -either alone or in social collaboration. Hence, for students to connect to the world, they must construct their own "wonderful ideas," move their ideas forward via exploration, discuss them with each other and (collaboratively) assess them against materials which provide reliable grounds. In this process students share with the teacher the responsibility of making sure they understand each other. This way, they do not just recount other people's ideas and learn for the test but develop greater confidence in their own ideas instead **??**Duckworth, 1987 **??**Duckworth, /2006). Therefore, it is a valuable and important cognitive and emotional experience for students to come to their own understanding, not through being told answers, but through the power of their own minds -often in interaction with others. A student-centered learning process leads students to ? have or develop a great sense of confidence in their own minds; ? bring their prior expectations and knowledge about a subject matter to the learning experience and then make a connection from the subject matter to what they already understand to reach an understanding of the subject matter;

? explore challenging questions and to figure things out based on their own interests; ? wrestle with their own ideas about a subject matter with confusions and conflicts being seen as valuable aspects of learning;

? try to make sense by testing ideas and posing questions, by thinking out loud and explaining what they think and why in a convincing fashion, and in the light of the phenomena they are trying to understand;

? have the courage to submit an idea of their own to someone else's scrutiny. Students form their own ideas, share what they think, see how their ideas relate to the ideas of others and are open to the questioning of their peers **??**Duckworth, 1987 **??**Duckworth, /2006, p. 67), p. 67).

A student-centered learning process requires students to consider and discuss each other's thinking in relation to their own thoughts and to their ongoing observations and explorations of the material proving ground. Thus, they develop their understanding of the subject matter and their ability to think further and gain confidence in their own minds.

c) The Role of the Teacher in the Learning Process The student's learning is the focus of teaching; therefore, the teacher's role is to help students learn.

The teacher facilitates learn ersso that they can have wonderful ideas on their own and realize the power of their own minds. Understanding requires searching thought about the nature of the subject matter on the part of the students and avoiding technical words to open a variety of connections to the subject matter. A teacher cannot assume that students have understood something because he has led them through it very carefully (Duckworth, 1999). Telling is not effective, especially when it comes to promoting higher order thinking processes, as Duckworth (in Meek, 1991, p. 30) points out: "telling people what they ought to understand has very little impact on what they actually understand. You have to put them in a situation where they develop that understanding -it's not going to happen from your telling them." **??**uckworth (1987 **??**uckworth (/2006)) highlights two main aspects regarding the role of the teacher as critical explorer:

a) The teacher puts students in contact with the phenomenonthe real thing -related to the area to be studied and gives them the space to explore what is interesting to them. He engages the students and puts authentic materials in the students' hands so they will continue to think and wonder about the subject matter. A good teacher knows how to get students interested in a subject matter/problem and keeps them interested in it **??**Duckworth in Meek, 1991).This brings the teaching and learning to life and sets up the subject matter as the source of authority. Students are attending to each other's thoughts and generate their own puzzles and questions while the teacher provides students with yet further elements of subject matter to help them to take charge of their own explorations of the subject matter and deepen their knowledge.

b) The teacher has the students explain the sense they are making and provides them with the time to create their own meaning while he is observing and listening. The teacher listens genuinely without trying to guide students' explorations asking, "What do you notice? What do you think? or How do you think about it?", for example. He keeps trying to find out and understand what sense the students are making and helps them to develop their ideas further offering new aspects for consideration while at the same time assessing and monitoring their progress. He attends to them with the neutrality of a researcher, that is, he reacts to the substance of their answers without judging them. The teacher invites students to talk and establishes their feeling of self-confidence instead of explaining things to the students and imposing his knowledge. In short, in the course of the educational process, engaging learners in phenomena and working to understand the sense they are making are the main aspects of teaching. This take on the educational process has further implications for the design of learning environments. The following Figure two summaries important core tasks of a teacher(teachingresearcher) as outlined above: Designing Student-Centered Learning Environments that Support Exploratory Learning Processes

Exploratory learning has its roots in the works of John Dewey, Jean Piaget, Friedrich Fröbel and Maria Montessori. The learner is considered to be an active explorer and discoverer building his own understanding while the teacher acts as a "guide on the side" to assist the learners' inquiry and help him engaging the learning

environment. An exploratory learning environment "supports learners in constructing their understanding about a specific subject through learner-driven reflective inquiry" **??** In order to make sense out of the world individuals need to make intellectual connections between their prior knowledge (internal structures) and the subject matter. Therefore, curricula need to provide occasions so that students can construct knowledge based on their own repertoire of actions and thoughts as there are endless numbers of adequate pathways for students to encounter and apprehend the material and make sense of the subject matter. Curricula must build on this diversity by engaging students intellectually and inviting them to explore the subject matter. A learning environment that provides a rich source of selected cultural, social and material resources can invite students to raise questions that concern them and contributes to a democratic classroom. Lectures are rare in such classrooms and the instructor does not talk too much in class but instead is mostly silent and listens very carefully to what the students are saying while trying to avoid any (judging) comments on students' ideas.

The instructor is the one who orchestratesexploratory activities, carries out demonstrations (modeling) and is mainly in charge of moderating large class discussions (including, for example, students' reflections on activities). Students explore and do the talking and explaining using artifacts as testing-grounds for their ideas and thus, as a source of authority. The teacher retains a focal role presenting engaging problems and attending to how students figure them out. She is continually tracking the students' investigations (observing, listening) to gain information about what to do next and she often provides queries and materials to take the students' thoughts further and keep them connected to the subject matter. By talking to students and engaging them with phenomena, instructors can prompt students to start thinking and to express their thoughts, and subsequently instructors can use their understanding to attend to the learner's sense making. The following characteristics and related roles of the instructor emerged from the analyzed data presenting implications for the creation of exploratory learning environments:

? Establishing a positive classroom climate and a productive learning culture

The overall atmosphere in the classroom both during class meetings and sections was described as "quite relaxing," "quite friendly," "lively," "fun," "fantastic," "positive" and "inclusive" by the interviewees, because "you could talk about everything that was on your mind." Students (and the instructor) sat in a big circle, called each other by their first names andstudents were activeconstructing knowledge ("doing"), participating in exploratory activities and discussions (involvement/interaction), and reflecting on the subject matter as well as on their learning processes. Students had the freedom to make choices with what and how to engage and they shared responsibilities with the instructor to make sure that everyone understood each other within a comfortable, responsiveand productive environment.

? Constructing knowledge through student-driven explorations and discussions It was the students who actively constructed meaning -individually and collectively inside and outside of the classroom. Thus, students shared responsibility and were held accountable for their own as well as for others' learning leading to increased autonomy on part of the students. The instructor provided space for student thinking and validated that thinking by making it auditable and visible to the entire group (e.g., students wrote on chalkboards, presented their solutions). Working on their questions and having some choice around what and how to explore helped students to come up with their own ideas, make more connections, deepen their understanding and get more engaged with the subject matter they were learning about (e.g., mathematical problem, poem).Class activities were designed to allow for individual or joint explorations and discussions orchestrated and facilitated by the instructor.

It was the students' work to figure out how to do the problem while negotiating different viewpoints and perspectives that could illuminate each other. Students also used a variety of resources to keep track of their thinking as a group. Confusions and conflictsheld students' minds to the problem, nourished their thinking andwere seen as a positive indication that real learning was taking place: While learning, students felt at times both "excited," "surprised," "engaged," "inspired," and "a little bit frustrated," "awful," "confused" or "bored."Because of their active involvement in and responsibility for knowledge construction in class, students experienced the power of their thinking understanding what other students said and building on each other's ideas and thus, positioning themselves as capable and independent. Her constructivist pedagogical viewpoint and respect for others' ways of understanding led the instructor to shift the power from teacher to students and to share responsibility for the direction the learning in the classroom had taken.

? Shaping and maintaining positive social relationships in a safe environment The instructor created a space where people felt safe and accepted and where they were encouraged to feel free to explore and talk. She modeled inclusive an appreciative instructional behaviors and flexibly structured the course to account for students' interests, ideas and questions. This way, students could feel that their ideas were worthwhile having and were motivated to following through. The class was a "very positive experience" for the students and a place where positive as well as negative emotions, like surprise, excitement, confusion and frustration, involved in the process of joint knowledge construction, were accepted. Students experienced the community as "incredibly supportive," were invested in each other's learning, and concerned about how others or the group as a collective was thinking about things. Students felt free to say something that they were not sure of and felt their ideas valued by the instructor and thus, could further develop their self-confidence as learners and thinkers.

Discussion and Conclusions: What to do With the Teacher's Knowledge?

Critical Exploration in the Classroom is an approach to teaching and learning that puts the students at the heart of the learning process. It is a fairly progressive approach involving two important roles that the instructor

plays: Engaging the learner with the phenomena (the real thing) or activity, and trying to understand students' explanations to help them learn. In order to learn and to make sense out of the world, the learners need to make intellectual connections between their prior knowledge (internal structures) and the subject matter by acting in the world **??**National Research Council, 2000Piaget, 1985). Teaching is then thought of as helping students to learn, i.e. to understand, so that they are empowered to realize their full potential **??**Duckworth, 1987 **??**Duckworth, /2006). Instead of teaching students what to think, the instructor teaches students how to think and the teacher becomes a facilitator of the relationship between the learner and the world. This combination of a researchers' and teachers' stance provides a window into the development of human minds for the teacher and at the same time helps the student to advance his understanding of the subject matter.

Based on the theoretical concept of Critical Exploration (section 2) and the empirical findings in the context of an empirical case study in the higher education classroom (section 3) the following features stand out in exploratory learning environments that bring Critical Exploration to life in the classroom: ? Practicing teaching by listening rather than by explaining: Instructors lecturing and trying to present the subject matter in a certain way by telling or explaining it to students can never be sure that the meaning they want to convey seems equally clear to individual learners. Thus, learners need to have the opportunity to reach out to the world, discover intellectually challenging problems, express their thoughts, raise questions, and construct knowledge based on their own repertoire of actions and thoughts. Students are asked to explain what they think and why and in trying to make their thoughts clear for others they achieve greater clarity for themselves.

? Engaging students intellectually and actively:

Instead of over-simplifying curricula and expecting students to thoughtlessly memorize a given absolute knowledge, learning situations should engage students intellectually and invite them into figuring out ways of creating meaning and solving problems. Instructors need to think about how to develop challenging problems to engage students' minds with the subject matter and put the learners into the forefront -letting them do the thinking, talking, explaining and discussing. Such pedagogy provides students with occasions to express their thoughts and understandings and to make their own connections.

? Creating a culture valuing lifelong learning with understanding: Deeper learning can be promoted or hindered depending upon whether social norms value the search for understanding, whether confusions are honored or whether students are encouraged and given the time to try out their ideas, for example. Therefore, it is crucial to create occasions where everyone has the opportunity to develop his or her potential to the fullest. A safe learning environment that provides a rich source of cultural, social and material resources invites the students to explore and raise questions that concern them and thus, learn deeply. In order to know whether students understand a given phenomenon or are on their way to understand and figure a problem out, teachers need to give them space to think on their own, choose their own path, and explain the sense they are making without forcing them to follow them jointly on their road. Instead of telling students what they know, teachers have to search for new strategies helping the students to build (jointly) on their knowledge and understanding taking their own thoughts further **??**Duckworth, 1987 **??**Duckworth, /2006).

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Figure 1: Figure 1 :

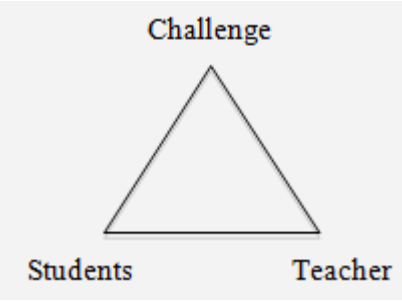

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Figure 2: Figure 2 :

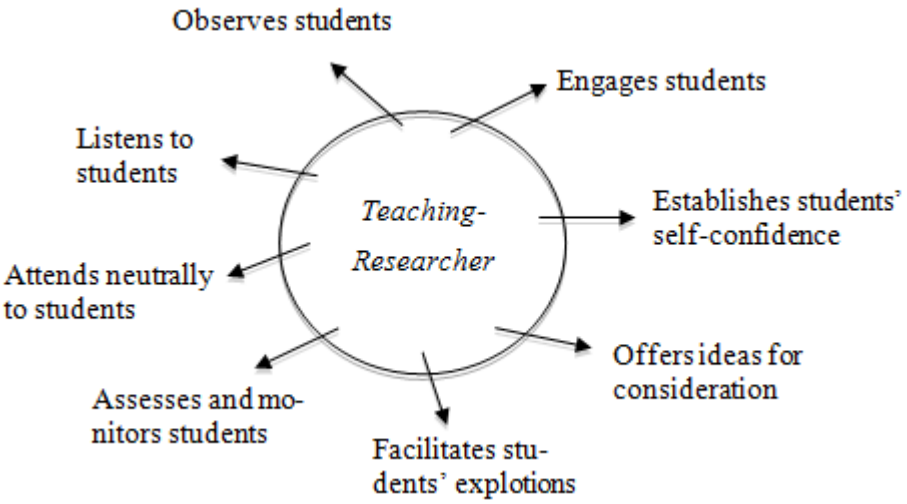

Figure 3:

Basic Components of Critical Exploration in the Classroom to Support Deep Conceptual Understanding

Figure 4:

viewpoints and pathways (students as co-designers);
? designs diverse class activities (exploratory activities, discussions, demonstrations) and related open-ended assignments aligned with assessment tasks;
? presentsstudents with interesting/stimulat
problems and materialsthat engage
challengethem, and spark their interest;
? organizes teaching and learning as an interactive process encouraging (joints)tudent-driven
explorations, discussions and reflections requiring high student involvement as well as shared responsibilities;
? supports classactivities withdifferent
artifacts/objectsin order to carry certain activities out, to make it easier for students to think about a problem and visualize their thoughts, and to use the material as the source of authority to test their ideas;
? is open to self-evaluation listening to students' feedback (e.g., course evaluations) and looking at what students are learning as a result of the classroom interaction to continuously improve her teaching.
b) Student-Centered Pedagogy

[Note: diverse ways into a subject matter, and has to find out what her students know about it trying to engage with students at their level of understanding; ? provides a fluent and flexible course structure/syllabus that can adapt to changes and incorporate a variety of students' ideas, questions,]

Figure 5:

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