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8.1 Reflection – A Genuine Element of Inquiry-Based Learning?

It is “self-evident” that reflection is a part of inquiry-based learning. One is given this impression as soon as one looks into descriptions of the concept: In the first list detailing the features of inquiry-based learning, which was created by the Federal University Assistants’ Conference (BAK) (1970, paragraph 4.21), we already find the following: “self-critical examination of the outcome in terms of its dependence on hypotheses and methods.” The term is included in definitions, for example in the oft-cited definition from Huber (2009, p. 10, translated):

In contrast to other learning methods, inquiry-based learning is characterized by the fact that learners shape, experience and reflect on the process of a research project, which is aimed at obtaining insights that are of interest to third parties, doing so throughout all the essential phases of said project: from developing questions and hypotheses, selecting and implementing the methods, through testing and presenting the results, either by working independently or in active collaboration with an overarching project.

This same impression is created by models of the phase cycle that inquiry-based learning should ideally undergo, not only as described by Huber (2009, also in the definition provided above), but also, for example, by Joachim Ludwig (2011): In each of the three types of “teaching in the format of research” distinguished by Ludwig (research-based, research-oriented, community), which accentuate different parts of such a cycle, reflection appears to be a central aspect. Schneider and Wildt (2009) formulate their “process model of inquiry-based learning” in a manner that is explicitly analogous to Kolb’s experiential

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learning, in which reflection of experiences gained acts as the starting point for new questions and hypotheses. Accordingly they define phase VII (after the phases of carrying through the research and evaluating the research results) as “interpretation of the data, reflection on the research process.” The words “reflection” and “to reflect” are also frequently found in reports on inquiry-based learning projects that have been conducted (cf. Huber et al. 2009, 2013; Lepp and Niederdrenke-Felgner 2014).

But perhaps, as is so often the case, there is an issue with the self-evident way in which the word is used: specifically the problem that it is in no way self-evident what is meant when these words are used. Therefore, in the following, I will attempt to develop what can and should be theoretically understood and to classify, or at least assume, what actually happens in practice.

8.2 Concept and Tasks of Reflection

8.2.1 Reflection from a Philosophical and an Educational-Theoretical Perspective

The word “reflection” has a long history in the philosophical tradition. In the course of this, the meaning of the word, which derives from optics, has gradually shifted from considering (originally: mirroring) a matter and reconsidering an idea to thinking about cognitive achievements, in accordance with Descartes’ “redirection of the knowledge interest from the subject matter to the act of knowing itself” (Schmidt and Gessmann 2009; cf. also Zahn 1992). The focus is thus placed on the “explicit raising of awareness and becoming aware of the subject and the activity of an act of knowing or act of will” (Brugger and Schöndorf 2010, p. 400). In the philosophical theory of cognition, in the case of Kant, in German idealism and even in phenomenology and existentialism, reflection acquires a changing but increasingly central significance. It is not our task here to refine this (cf. however Zahn 1992).

In everyday language following the usage in French or English, “reflection” or “to reflect” is frequently used to simply mean “to consider, or regard in a contemplative manner.” In addition, reflection can mean integrating the respective facts within a wider context or considering them from another perspective.

In scientific activity, the role of reflection also includes: Raising awareness of the activity and experience, of the decisions that have been made more or less unconsciously, of the cognitive process and the factors that influenced that process. Similarly this is its role in inquiry-based learning insofar as, like every course of study according to Humboldt, such learning refers to the beginning participation in the work and community of those pursuing science by teachers and learners (cf. Humboldt 1810/1964, p. 256).

At the same time, inquiry-based learning can be regarded as that form of study in which “education through scholarship” (*Bildung durch Wissenschaft*) is most likely (possible), because “knowledge is always treated as a problem that is not yet completely resolved”

and therefore “one always continues to research” (ibid.). The concept of education (*Bildung*) is also associated with reflection (or also “reflectiveness”; cf. e.g. Hentig 1980, p. 180 et seq.). In Humboldt’s considerations on the matter – to draw on him once again – the word reflection does not appear, but the meaning of the concept does indeed: It is constitutive of his concept of the education (*Bildung*) of mankind that said individual “seeks [] to grasp as much world as possible and bind it as tightly as he can to himself” (1794/1960, p. 235, translated), but not to lose himself too fully in one thing or in the diversity of objects itself, but rather to place everything “in relation to our inner education”. This is why he seeks “allness” (*Allheit*), coherence (an “overseeable circle”), a “final purpose” (*letzter Zweck*) in his thinking. This “process of our mind [...] can only be fathomed by profound reflection and constant observation of oneself” (ibid., pp. 237–239; cf. also 1810/1964, p. 258, translated). Elsewhere, Humboldt makes clear that individuals cannot acquire this education on their own: The problem of the difference between the universality of thought and the particularity of practical decisions must “be resolved in such a way that his [the individual’s] own advance toward the goal simultaneously promotes the universal approach thereto, and indeed directly and immediately [...]” (1797/1960, p. 508; cf. also p. 511 et seq., translated).

The “science” (*Wissenschaft*) that Humboldt had in mind, however, was philosophical and included the humanities, in contrast to the “collecting sciences,” which were separated from it. Reflection on the process of cognition itself is therefore inextricably linked with “science.” According to Humboldt’s understanding of “science,” its continued reference to the universal must per se overcome all ties to particular perspectives and purposes (Humboldt 1810/1964, pp. 258, 261). Since it is no longer self-evident, if indeed it ever was, that this can be expected of the particularized disciplines of today, this raises the question as to what supplementation is required for the study of said disciplines. Clearly the postulation that, for any knowledge one discipline must supplement the other, is no longer sufficient (cf. also Schleiermacher 1810/1956, p. 223 et seq., as well as Brüggem 1988, p. 310 et seq.), and what is instead at issue is confronting overarching questions, the problems of society, even of humanity, which exceed the segments of problems addressed by individual disciplines, but which nevertheless need to be dealt with by the sciences together.

This is because, in the meantime, the sciences have become a problem in a completely different sense. They have produced the possibility of means for the total destruction of the world (nuclear physics), irreversible changes to life (molecular genetics), the permanent pollution of the natural environment, the control of information and the manipulation of individuals, groups and entire societies: Simple harmony is no longer possible between this version of science as a technical disposition and regulation of the world, and the view of education as a “reflective self-understanding of man” (cf. Benner 1990, p. 598 et seq.). Even “reflection” must be comprehended in a more complex way: Specifically in the confrontation with the key problems mentioned above, in particular the destruction of the environment and the global, universal and irreversible risks which are produced simultaneously when technological advances are made, science encounters its own actions and their

consequences, and in turn has to invent new means to combat said consequences. Similarly, industry is expanding with products that are needed to offset the damage caused by previous ones. As Beck (1986) understood in his fruitful analysis of these developments, this is the sciences becoming reflexive (reflecting back on themselves) in the sense of a confrontation with the consequences of their own actions. Although one might contend that modern science does not think (philosophically) while in action, scientists should, in fact, reflect in this way when reviewing their actions. The reflection intended in the educational ideal, at any rate, is self-reflection by those engaged in science with regard to the process.

Benner (1990, p. 609 et seq.) combines both the traditional and the present understanding of this demand for self-reflection in a model of “the four levels of an educational interpretation of modern science”: Completion of knowledge acquisition in discourse (message, dispute, understanding); transcendental philosophical reflection on limitations in the validity claims of scientific statements; epistemological reflection on its historical-social origin and new applications; and questioning the scientific statements in terms of their meaning in and for reality while reflecting on the situational context of dealing with them.

Thus if education through scholarship (*Bildung durch Wissenschaft*) is still possible at all and if inquiry-based learning is to serve this purpose, then it will only be through the power of reflection: “education through scholarship requires the intensive active examination of how science is conducted” (cf. Brinckmann et al. 2002, p. 29; Brunkhorst 2002, p. 246). On the other hand, while certainly also a goal and component of “education through scholarship” (*Bildung durch Wissenschaft*), “critical thinking” has an even greater significance insofar as it generally questions social relationships and processes and the justifications thereof. Summarizing the considerations so far, there are three dimensions to reflection as defined here: the self-reflection of scholarship as a mode of rational cognition, the self-reflection of the subject through scholarship, and the reflection on the common good to be promoted thereby. Autonomy and social responsibility both belong here as goals (cf. Euler 2005, pp. 255, 263 et seq.).

8.2.2 Reflection from the Perspective of Experiential Learning and Professional Practice

The reasoning for reflection presented so far has been based on its importance to scholarship, in particular to the goal of education through scholarship (*Bildung durch Wissenschaft*), which, in turn, is especially bound to the concept of inquiry-based learning. Another line of reasoning could be derived from the importance of reflection for continued learning by individuals and organizations in a concept of learning based on reflective experience. It would go beyond the scope of this project to present the development of this from Dewey and Lewin to Kolb. In any event, it has also become important in understanding the practice and justification of professions that cannot simply apply laws or technologies to the complexities of the problems and situations they face, but that also cannot continue to

develop if they only cope with unexpected problems more or less successfully within a given situation itself (“reflection *in* action”; cf. Schön 1983): Instead, they must develop orientations and justifications for future action based on the subsequent reflection on such actions and experiences (“reflection *on* action”) (Schön 1987, p. 31). In this sense, “reflective practice” is the motto of many writings and discussions regarding professions such as health and education. In view of the dissolution of many hitherto stable boundaries, this could also be the case in academic life and in science as a profession. Following the lead of Gibbons et al. (1994), in “mode 2,” modern science is increasingly project-oriented, transdisciplinary, contextualized and thus confronted with structuring problems that change based on the situation, while “mode 1” describes the traditional production of knowledge in accordance with disciplinary paradigms.

From this perspective, it is necessary to conclude that reflection is also highly significant for professional education, in terms of both studies and training (for example, in dealing with initial practical experiences). Curricula should be measured by the degree to which they create space and opportunity for this purpose. As far as I can see, the most advanced are degree programs in medicine, in which elements such as early practical experiences and reflective seminars on ethics or health policy hold a notable place. In many instances this also applies to teacher education. Here, the compulsory internships are often the subject of explicit exercises in reflection, for example in the writing of practical reports or the evaluation of portfolios, sometimes also connected with access to this practice in the form of inquiry-based learning (cf., only by way of example, the anthology by Schüssler et al. 2014, and in particular the article by Valdorf et al. (2014) in that anthology).

With these considerations, however, one enters a new, much wider field, actually that of study itself; while many issues also arise from the concept of inquiry-based learning in general, in the following I shall again limit myself to the discussion within the context of education through scholarship (*Bildung durch Wissenschaft*).

8.2.3 Reflection Within the Context of Inquiry-Based Learning

From the above, it will also be possible to develop questions for reflection within the context of inquiry-based learning. These go in three directions:

- science as a mode of rational cognition, i.e. the research which is pursued in the respective project considered from an epistemological viewpoint: cognition-inducing interests; explicit and implicit premises, the decisions made regarding the question, choice of method, etc. in terms of where the focus is placed and what is dismissed, the scientific status of the results and their dependence on the design and methods of the study;
- science in its relationship to the common good: the social relevance of such research as currently experienced, the relationship of general and particular interest, especially in contract research or the use of research to provide consulting and, associated therewith,

the problems of publicness and confidentiality, issues of research ethics (in the forms of the study) and scientific ethics (integrity, etc.);

- science as a subjective learning process and experience in the course of the project: in terms of content (learning problems, stages, aporia, insights...) and social aspects (relationships and collaboration in the group, with the educators/supervisors, etc.).

It hardly needs to be emphasized that each of these directions of reflection is important, demanding and facilitative, especially in projects related to inquiry-based learning. In view of the unavoidable limitations on student projects, e.g. the consequences of limited methodologies and the scope and validity of the results are particularly important in the first of these directions. In the second direction, for example animal experiments and the implications thereof or – as is the case in many of the possible and popular projects at many universities of applied sciences – the particular interests of the party commissioning the study in their charged relationship with the young researchers' advanced perspectives on the problem provide a great deal of material for discussions about research ethics. Finally, in the third direction, there may be an intense connection with the level of meta-learning which is so important to the entire course of study.

Since, in our context, inquiry-based learning does not simply deal with individual education through scholarship (*Bildung durch Wissenschaft*), but also with a didactic format in higher education, as with other teaching and learning methods, reflection on the course (or, respectively, the project) comes up as an additional direction that reflection can take: facilities, organization, equipment, etc. In the case of topic forums, for example, the organization, coordination and supervision support are reflected upon. Questions and answers from the process typically referred to as *evaluation* can also be used for such reflection.

Summarizing the previous considerations, we can say: If reflection is an element of professional scientific work for ethical as well as functional reasons, it must also be an element of inquiry-based learning. This reflection is therefore involved in setting goals for this learning and, as such, as a means to an end. Undoubtedly, however, the capacity for reflection is a competence unto itself, can be described as such and can be transferred to other forms of professional action; in this regard, reflection can also be regarded as a goal unto itself and as one of the competences that can be further developed through inquiry-based learning.

8.3 Forms of and Situations for Reflection in Inquiry-Based Learning

There is no question that reflection can be combined with any activity in inquiry-based learning: potentially every step offers an occasion to pause, to be aware of what you are doing and why, the purpose thereof and what you feel.

Nevertheless, it is possible to single out special opportunities for reflection. Such situations include those where there is a transition from one phase of the process to another.

In many project reports, it can be seen that stages are already set up at caesuras, at which otherwise independent project teams involved in the research come together in the plenary session provided by the class in order to mutually report to one another about the project and their plans for the next phase. It only takes one additional step and a little time, also, to reflect on experiences and intentions. Reflection can become a primary topic in the introductory and final phase: at the beginning because there are immediate questions regarding the interest, topicality, relevance, and possibly even the ethics of the research under consideration, and at the end because not only the significance of the findings and their possible consequences, but also the process through which those findings have been reached must be assessed and conclusions drawn for future work.

The situation is similar for the forms and media of reflection beyond quiet individual reflection. The natural and most obvious of these is oral communication among those involved or other interested parties, for example in the situations mentioned above. However, given the time intervals between these situations as well as the variety and rapid succession of tasks and impressions, it is advisable to record reflections during the process, in particular by writing them down so that they may be introduced in the midst of that exchange. Means for doing so include field notes, work journals, interim reports, learning journals or portfolios; this may also comprise drawings or images. The act of writing things down itself holds the potential for a reflective process (cf. Bräuer 2003; Lahm 2015). In larger rounds of discussions, for example in plenary session for a project or, respectively, a course, short phases of note-taking in the form of *one-minute papers* or cards help all those involved to be sure of their thoughts and see that these are factored in. *Peer reviews* could also provide students with another entry point, if created and recorded appropriately.

So far, little is known about what use participants in courses using inquiry-based learning make of these options. Published reports, for example in anthologies that have appeared in recent years – examples of which include those from Huber et al. (2013) and Lepp and Niederrenk-Felgner (2014) – have thus far scarcely been productive regarding the question how to deal with reflection. This does not mean that it does not exist, but for the time being it only confirms, as already stated, that reflection is rarely discussed. Many activities are reported that can smoothly lead to reflection, and that perhaps have already done so; one example is scrutinizing central concepts that determine a problem (example: The students “scrutinize [...] the current inflationary and in particular often abusive use of the concepts of ‘sustainability’” in a course entitled “Innovation for Sustainability,” see Arndt 2014, p. 102), or they sometimes scrutinize the assurance “in specific places” that the path they have taken is correct (Lepp 2014, p. 37), or, frequently, scrutinize the critical assessment of (intermediate) results (Gervers 2014, p. 135; Schmidt et al. 2013, p. 180). Evaluation questions that require self-assessment, such as one’s own participation or acquisition of competencies, can act as a step into self-reflection.

Guidelines for learning reports or portfolios often include sections for reflection (mentioned, for example, by Lorenzen et al. 2013, p. 154 et seq.; or Kaufmann 2013, p. 133; in “Reflection texts on the research process and teamwork” (“Reflexionstexte zum

Forschungsverlauf und zur Teamarbeit”) as material for the final overall interpretation, *ibid.*, p. 137). Reflection is rarely (and the competence of reflecting) explicitly named among the learning objectives (if any), almost as though one need not or could not learn it. To summarize, even where reflecting or reflection are mentioned, nothing more is said about what was reflected upon, how extensive or how deep this reflection was and in what forms it was communicated and discussed.

In a short working phase which was dedicated to our topic during the meeting of the working group for inquiry-based learning of the Deutsche Gesellschaft für Hochschuldidaktik (DGHD) (German Society for Higher Education Didactics) within the context of the annual meeting of the DGHD in Paderborn on March 4, 2015, most of the situations and forms of reflection mentioned above were mentioned once or twice as possibly occurring. There were additional suggestions made that could also serve the purpose of promoting reflection such as tutorials or mentoring sessions, team meetings or fireside chats, research workshops or special interviews. However, the predominant impression was that at least those higher education didactic experts who must support or evaluate inquiry-based learning projects thus know far too little about what actually happens in the process of such projects in order to facilitate and promote reflection. A significant task of future supporting research looms here.

The picture was clearer for continuing education of educators in a higher education setting insofar as that staff development is offered by higher education didactic experts. In any case, according to the oral reports at this gathering, such education is frequently designed in such a way that fruitful occasions exist for professional and scientific self-reflection by educators, which are in fact utilized: joint curriculum planning, co-teaching and collegial advice in terms of self-understanding as educators, setting goals, choice of methods, etc. An interdisciplinary composition of the groups is also seen as an opportunity for changing perspectives and questioning the self-evidence of one’s own disciplinary culture, evaluating one’s own teaching or even researching it. How much of the kind of reflective activity that they experience in such settings educators subsequently transfer to their courses and practice there with students remains an open question, however, and one that calls for investigation.

Ultimately, this is true of inquiry-based learning in general. A reflection on reflection itself and reassurance about its practice in inquiry-based learning projects is essential.

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