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KNOWLEDGE BUILDING AS THEORY DEVELOPMENT IN EDUCATION: WHAT FORMS OF PROGRESSION AND IN-DEPTH LEARNING ARE POSSIBLE IN THE SUBJECT OF SOCIAL SCIENCES?

Introduction

Education is changing all over the world. Neoliberal educational reforms have the aim to bring education closer to society and a new knowledge-based working life[1]. These reforms, which were realized differently in different countries, have in common that they pushed knowledge out of school, replacing it with skills and new competences[2]. The new Norwegian curricular reform can be seen as an attempt to halt this development by a stronger emphasis on knowledge in education[3]. In-depth learning and in-depth knowledge are central terms in the new Norwegian curricular reforms (LK 20). These concepts imply a specific understanding of progression in education and aim at developing a deeper understanding of selected topics in the subjects where the students acquire a deeper knowledge about the world. The reform, as it is currently presented by the authorities (Meld. St. 28, 2015-2016), provides contradictory answers of how the aim of in-depth learning should be realized. The reform, which had the intension to renew the subjects, is described as putting a stronger emphasis on subject knowledge and less emphasis on superficial knowledge; subjects are to become more practical, more creative, and more explorative. However, it is not clear how these elements are related to each other and whether they really lead to in-depth learning in the classroom.

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[1] H. Lauder, et. al (Ed.) (2012). *Educating for the knowledge economy?: critical perspectives*. London: Routledge.
[2] L. Wheelahan, (2010). *Why knowledge matters in curriculum: a social realist argument*. London: Routledge; Young, M. F. D. (2008). *Bringing knowledge back in: from social constructivism to social realism in the sociology of education*. London: Routledge.
[3] E. Bratland, (2019). *Social realism and in-depth learning: Can students build knowledge with an epistemic dimension?* Cognitive Science - New Media - Education, *5*(2), 9-22. doi:http://dx.doi.org/10.12775/CSNME.2018.008.

The problem of knowledge and cumulative knowledge building in education is the main focus of this paper. While the new Norwegian curriculum implies that knowledge in school is a neutral category, this paper presents an opposing point of view: Forms of knowledge in the subjects are different, and knowledge practices in the subjects affect how progression and in-depth learning are realized. While in-depth learning in the sense of an increased comprehension often is illustrated with examples from the natural sciences[4], it is less clear whether and in which way in-depth learning and progression can be realized in the social sciences. Based on Bereiter & Scardamalia 2012, Bernstein (1999, 2000) and Maton (2014), this paper investigates what kinds of progression or cumulative knowledge building can be realized in this subject. It will be argued that cumulative knowledge building is possible in the social sciences, but that it will have to have a different character in comparison with the natural sciences. With a starting point in social realism, and partially based on my own research, I will discuss what forms of progression are possible in the social sciences and how knowledge building can support this aim.

Theories of knowledge and knowledge building in the social sciences

Teaching with the aim of in-depth learning, a deeper understanding, is not a new idea in educational research[5]. In fact, teaching with an aim of gaining a deeper understanding is an ideal with a long history, and it has often been illustrated with examples from natural science teaching[6]. The development of knowledge in the natural sciences in the sense of developing more general theories that can explain the natural world have become a standard for research and teaching. However, the social sciences cannot simply implement those standards because these subjects are different. The social world comprises a different type of knowledge, which has to do with people, actors and social structures, in short another object of study[7]. Bereiter and Scardamalia (2010, 2012) nevertheless argue that knowledge building in the social sciences is possible but that it must respect the peculiar character of these disciplines. While the natural sciences are based on the exploration of the natural world, generating comprehensive ideas and theories that can explain a number of natural phenomena, social sciences are characterized by particular cases leading to the development of theories that can explain these particular cases. With this background, Bereiter and Scardamalia (2012) argue that knowledge building in the social sciences is marked by the building of theories that can explain particular cases. In order to decide whether a theory is better

[4] C. Bereiter, & M. Scardamalia, (2010). *Can Children Really Create Knowledge?* Canadian Journal of Learning and Technology, 36(1). Retrieved December 3, 2018, at http://www.cjlt.ca/index.php/cjlt/article/view/26377; Bereiter, C., & Scardamalia, M. (2012). *Theory building* and the pursuit of understanding in history, social studies, and literature. In J. R. Kirby & M. J. Lawson (Eds.), Enhancing the quality of learning : dispositions, instruction, and learning processes (pp. 160-177).

[5] K. Leithwood, M. Dubowe, (2006). *Teaching for deep understanding: what every educator should know*. Thousand Oaks, California: Corwin Press.

[6] C. Bereiter, & M. Scardamalia, (2012). *Theory building and the pursuit of understanding in history, social studies, and literature.* In J. R. Kirby & M. J. Lawson (Eds.), *Enhancing the quality of learning : dispositions, instruction, and learning processes* (pp. 160-177).

[7] T. Benton, I. Craib, (2007). *Philosophy of Social Science: The Philosophical Foundations of Social Thought*. Basingstoke: Basingstoke: Macmillan Education UK.

or more true, in relation to alternative theories, Bereiter and Scardamalia refer to Thagard's[8] principle of *explanatory coherence*. This principle supports the idea of the best explanation and states that a good theory in the social sciences should be able to provide a coherent explanation of all known and accepted facts in a case but not of the conditions outside the respective case. Seen from a social and realistic perspective[9], the last part of this principle is too restrictive and even misleading, because theories in the social sciences commonly encompass underlying mechanisms and structures, exceeding a particular case[10]. In fact, the function of the social sciences theories is that they provide us with explanations of underlying conditions and mechanisms in the social world. Bereiter and Scardamalia's shortcomings on this point are due to the fact that they lack an adequate theory of knowledge in education. The principle of explanatory coherence is nevertheless fruitful, searching for the best explanation in a particular case, which may lead to deeper understanding. I will use this idea as a starting point for my further discussion of knowledge building as theory development in the social sciences.

Bereiter and Scardamalia's version of knowledge building as theory development in the social sciences is a good starting point, but it presents as mentioned some clear shortcomings seen from a social and realistic theory of knowledge in education[11]. In his theory of knowledge structures, Bernstein (1999, 2000) distinguishes between hierarchical structures and horizontal knowledge structures. While knowledge structures in the natural sciences are characterized by development towards more abstract and general theories, integrating earlier theories in the field, the social sciences are marked by horizontal knowledge structures with a number of incommensurable and equivalent theories where development means the emergence of a new theory[12].

Sociology is one of the social science disciplines, and according to Bernstein it is a discipline with a limited ability to integrate theories. This is caused by the fact that every theory operates with its own concepts and definitions, leading to disagreement and to different explanations that cannot be evaluated by their relation to accepted facts or data. The social sciences have a peculiar character, which means that disagreements and various explanations cannot be settled by accepted facts or data. The peculiar nature of social sciences is not only related to investigations of particular cases, but is also marked by the fact that the same actions, events or phenomena are interpreted in different ways, depending on the theories and concepts that are applied. This situation leads to ideological disagreements between different positions in the discipline, but it also causes fragmentation and segmentalism, limiting the ability for cumulative knowledge building in the social sciences.

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[8] P. Thagard, (2000). *Coherence in thought and action.* Cambridge, Mass: MIT Press.
[9] K. Maton, R. Moore, (2010). *Social realism, knowledge and the sociology of education: coalitions of the mind.* London: Continuum.
[10] L. Wheelahan, (2010). *Why knowledge matters in curriculum: a social realist argument.* London: Routledge.
[11] K. Maton, R. Moore, (2010). *Social realism, knowledge and the sociology of education: coalitions of the mind*. London: Continuum.
[12] B. Bernstein, (2000). *Pedagogy, symbolic control and identity: theory, research, critique.* Lanham: Rowman & Littlefield, p. 157.

Bernstein's insight that the social sciences are characterized by horizontal knowledge structures with a weak grammar sheds light on some fundamental problems linked to the principle of explanatory coherence and creates doubt about whether knowledge building as theory development is possible in the social sciences. Bereiter and Scardmalia's[13] idea of knowledge building as theory development presents several grave problems in social sciences: Theories cannot be integrated with other theories, accepted facts are interpreted in different ways, depending on the applied theory and its concepts. This creates variations in terms of what counts as legitimate knowledge, often depending on ideology and standpoint as well as the programs and practices in the subject[14]. It is not clear how these problems can be overcome, and if so, in what way cumulative knowledge building can take place in social sciences.

This question is complex and encompasses several dimensions, particularly associated with the relationship between theory and data. Bernstein (1999, 2000) himself has given a partial answer to this question by referring to the fact that there are social science disciplines, such as economy, with a horizontal knowledge structure with a *strong grammar*. The strength of the grammar depends on the character of the theories. Subjects with a strong grammar have theories with a conceptual syntax allowing "precise empirical descriptions and/or of generating formal modelling of empirical relations"[15]. What this statement implies and how it can be related to an educational context will be further discussed below.

The discursive gap and progression in the social sciences

Segmentalism is a considerable problem in education (Maton 2014). This problem prevents progression and a deeper understanding and arises when knowledge are strongly context-bound. This problem has not been diminished in times when the current ideal in the social science curriculum are student-active and explorative forms of learning[16], often coupled with the use of technology. Exploratory forms of learning can lead to segmentalism, where students in school acquire local and context-related forms of knowledge. Scardamlia and Bereter's theory is an attempt to overcome this problem, by emphasizing knowledge, or more precisely by focusing on theories and ideas in education.

[13] C. Bereiter, M. Scardamalia, (2012). *Theory building and the pursuit of understanding in history, social studies, and literature.* In J. R. Kirby & M. J. Lawson (Eds.), *Enhancing the quality of learning : dispositions, instruction, and learning processes* (pp. 160-177).

[14] R. Moore, (2013). *Social Realism and the problem of the problem of knowledge in the sociology of education.* British Journal of Sociology of Education, 34(3), 333-353. doi:10.1080/01425692.2012.714251.

[15] B. Bernstein, (1999*). Vertical and horizontal discourse: An essay. British Journal of Sociology of Education.*, 20 (2), p.164.

[16] A. Lund, T.E. Hauge, (2011). *Designs for teaching and learning in technology-rich learning environments.* Nordic journal of digital literacy [electronic resource](4), 258-272; Bratland, E. (2019). *Social realism and in-depth learning: Can students build knowledge with an epistemic dimension?* Cognitive Science - New Media - Education, 5(2), 9-22. doi:http://dx.doi.org/10.12775/CSNME.2018.008.

The use of concepts and theories can contribute to cumulative knowledge building in social sciences, but as Bereiter and Scardamalia[17] point out, this is not sufficient. Students gain a deeper understanding when theories and concepts are seen as an area for development with a starting point in the specific forms of knowledge of the social sciences. According to Bereiter and Scardamalia, knowledge building as theory development in the social sciences will typically be enacted in the form of the "theory of the case," where a limited number of phenomena is explained based on the relevant theories and concepts in the social sciences. With a beginning in the principle of *explanatory coherence*, Thagard[18] argues that a good theory will be able to provide a coherent explanation of all the present facts in a given case. Knowledge building as theory development in the social sciences can be carried out by finding the best explanation, by creatively adapt and develop an existing theory, and even combine theories that can explain different sides of a particular case. For example, the spread of Protestantism in the Middle Ages in Europe can be related not only to Weber's value-based theory but also on the basis of Marx, who's stresses the material conditions in mediaeval Europe[19]. In this example, Fukuyama demonstrates how knowledge building as theory development can lead to a deeper understanding of a particular historical case, and this provides us with a new understanding of what progression and in-depth learning in the social sciences could mean.

In the meantime, Bernstein has pointed at some problems that by no means are solved in Bereiter and Scardamalia's (2012) model. Bernstein (2000), who was especially interested in the production of knowledge, pointed at two underlying problems that mark the social sciences. These problems, which are linked to the horizontal knowledge structures of the social sciences, show so that there is a need to develop the proposals of Bereiter and Scardamalia. Knowledge building as theory development requires further clarification of how the serial character of the social sciences, consisting of a number of equivalent and separate theories, can be managed in a way that knowledge building as theory development can happen in the social sciences. The horizontal knowledge structure implies that the social sciences cannot be developed in the same way as the natural sciences with their integration of theories allowing the development of increasingly abstract and general theories. However, this limitation is not in itself decisive for cumulative knowledge building. In subjects with horizontal knowledge structures, it is the strength of what Bernstein refers to as grammar that will be crucial. In other words, theory developed in the social sciences will only to a limited degree depend on the integration of theories, which explains a larger number of phenomena and facts, mirroring the situation in disciplines with hierarchical knowledge structures[20].

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[17] C. Bereiter, M. Scardamalia, (2012). *Theory building and the pursuit of understanding in history, social studies, and literature.* In J. R. Kirby & M. J. Lawson (Eds.), *Enhancing the quality of learning : dispositions, instruction, and learning processes* (pp. 160-177).

[18] P. Thagard, (2000). *Coherence in thought and action.* Cambridge, Mass: MIT Press. L. Wheelahan, (2010). *Why knowledge matters in curriculum: a social realist argument.* London: Routledge.

[19] F. Fukuyama, (2018). *Identity: the demand for dignity and the politics of resentment*: Profile Books, p.27.

[20] K. Maton, J. Muller, (2008*). A sociology for the transmission of knowledges* In F. Christie & J. R. Martin (Eds.), *Language, knowledge and pedagogy : functional linguistic and sociological perspectives* (pp. 14-33). London, New York: Continuum; Moore, R., & Muller, J. (2002). The Growth of Knowledge and the Discursive Gap. British Journal of Sociology of Education, 23(4), 627-637.

Theories in social sciences can be developed in a cumulative way based on whether they provide better explanations, by combining theories and concepts in new ways, by creating new and customized definitions, and by developing new theories (Bratland 2019). However, in order to realize Thagard's principle of explanatory coherence, the theories must allow some degree of compatibility so they can be compared and combined in the same way, as in the example above where Fukuyama explains the growth of Protestantism in Europe. Bernstein's concept of strong grammar provides the conditions for knowledge building as theory development in the social sciences, depending on theories that allow precise and combined empirical definitions. The question remains how and whether knowledge building in the social sciences can realize these demands.

The conditions for theory development and cumulative knowledge building in the social sciences are challenging and requires that it will be possible to treat various theories in the same way, making them comparable and allow to relate them to the same set of accepted facts. This is not the whole story, however. In order to link theories and data, it will be necessary to create an intermediary level that can bridge the discursive gap between theory and reality as it is represented in empirical data[21]. The relation of theories to data requires a translation device; something Bernstein phrases as an external language enabling theory and data to communicate. My own example below shows the construction of an translation device describing categories that is translated from the concepts of the theory (see figure 1). The lack of such translation device opens up space for ideology creating a situation where selected information or data appears to support the assumptions and extra-explanatory functions (primarily standpoints and interests) that are built into a number of social theories without replicating its causal mechanisms. Since the social sciences from the outset have parallel theories without common definitions, it is necessary to provide an external language that relates to the conceptual definitions of the theory or to provide customized version of the language used by different theories. Data can lead to theory development realizing Thagard's demand of explanatory coherence, when there is an comparability between theories, their internal languages, and the development of an external language, discussed as a translation device. Once a mutual connection between internal and external language is established, it creates a new space where the search for the best explanation can lead to conceptual improvement developing new ideas and concepts in a way that allows knowledge building as theory development. The discursive gap between theory and reality will not disappear[22], but theories and concepts linked to explicit principles for describing empirical categories have the potential to create cumulative knowledge building in the social sciences, with better explanations of the social world both in research and in education. However, such an approach, with knowledge building as theory development in education, will depend on the cultivation of knowers, which is the topic for the following section.

[21] R. Moore, J. Muller, (2002). *The Growth of Knowledge and the Discursive Gap*. British Journal of Sociology of Education, 23(4), 627-637. doi:10.1080/0142569022000038477.

[22] R. Moore, J. Muller, (2002). *The Growth of Knowledge and the Discursive Gap*. British Journal of Sociology of Education, 23(4), 627-637. doi:10.1080/0142569022000038477.

Knower structures and progression with cultivated gazes in the social sciences

A subject area in education does not just consist of knowledge structures but also of knower structures (Maton 2014). As Maton has pointed out, knowledge and knowledge practices in education are more than epistemic relations, as they also imply social relations. The social sciences have for many decades been marked by standpoint theories such as Marxism, feminism, multiculturalism, and postmodernism with their underlying social constructivism, where the social relations implied in knowledge have acquired a strong position[23]. Even though social sciences contains a striving towards the knowledge ideal of the natural sciences, this tendency conflicts with Bernstein's term[24], where the social sciences is characterized by a horizontal knowledge structure with a weak grammar. The knowledge structures of the subject may favor a knower position with strong social relations, limiting the possibilities for cumulative knowledge building in the subject. The knowledge structure of a discipline not only depends on how the subject has been institutionalized into different fields but also how it is being carried out in education through the existing forms of knowledge practices. To understand what kind of knowledge that characterizes a subject or a program, in other words the strengths of the social and epistemic relations, it will be necessary to study the practices in the subject. With a starting point in Maton's LCT-theory (2014, et al 2016), I conducted two different pilot studies of the social sciences in teacher education at Nord University. In the first study, students were asked what it takes to have success in the subject, and the answers gave a clear picture of the students teachers perceptions of bases for achievement in the social sciences, a subject where epistemic relations are stronger than social relations, which implies that the subject is dominated by a knowledge code[25]. Apparently, this code seems to secures cumulative knowledge building in the social sciences, but as Maton (2014) has pointed out, knowledge practices also depend on the characteristics of knower structures in the subject. Inspired by Bernstein, Maton (2014. p. 95) distinguishes between four different forms of gazes:

- Stronger knower-grammars: born and social,
- Weaker knower-grammars: cultivated and trained.

Our ideas about truth and reality depend on the form of gaze, in particular in subjects with horizontal knowledge structures. The mentioned four gazes are characterized by their own legitimation, expressing what kind of achievements witch are emphasized in the subject, and the qualities of an ideal knower. Of the four gazes only the gazes with weaker

[23] R. Moore, (2013). *Social Realism and the problem of the problem of knowledge in the sociology of education.* British Journal of Sociology of Education, 34(3), 333-353. doi:10.1080/01425692.2012.714251.

[24] B. Bernstein, (2000). *Pedagogy, symbolic control and identity: theory, research, critique.* Lanham: Rowman & Littlefield.

[25] E. Bratland, (2016a). *Knowledge building and ICT in subjects: How to make knowledge and knowledge practices more central in educational ICT-research?* In E. Baron-Polańczyk (Ed.), ICT in educatinal design (Vol. 10, pp. 49-60). Zielona Góra University Press.
E. Bratland, (2016b). *The rules of the game: What role do specialized codes in the subjects play for the use of ICT in education? I*n D. Siemieniecka (Ed.), Education and new technologies in culture, information and communication (pp. 23-40). Toruń: Adam Marszałek.

knower grammars allow a larger degree of progression, where the ideal knower is formed by education, i.e. interaction with "significant others." In school and in teacher education, subjects with horizontal knowledge structures with stronger epistemic relations will commonly have a cultivated gaze. However, the progression with cultivated gazes may vary significantly, which my study of social sciences in teacher education demonstrates[26].

With a starting point in the concept of semantic gravity, which forms part of the LCT-theory (Maton 2014), in 2015/16 a comparative case study with a focus on student papers in history (23 students) and geography (31 students) was conducted (Bratland 2018). *Semantic gravity* refers to the context-dependence of meaning, which can vary in strength, graded from strong to weak dependence on the context. To analyze the student papers, their semantic strength and degree of context-dependency, a translation device was developed including a set of categories that allow the coding of data[27]:

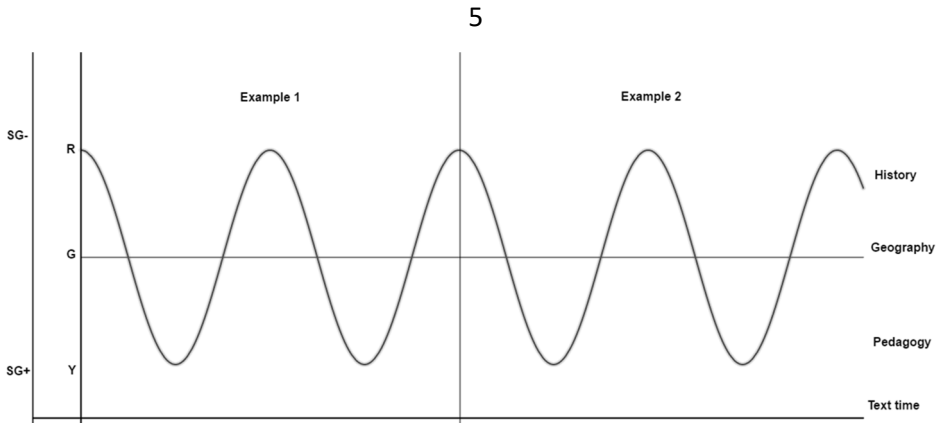
Figure 1. An external language for description of semantic gravity (description of coding)

Sematic Gravity	Coding categories	Description of coded content
Weaker (SG-)	Red (R)	Students describe a theory, concept, or principle in a general manner, without reference to experiences, social conditions or own assessments
	Green (G)	Students describe the object, by reference to various sources, but without explicit references to relevant academic theories or explanations.
Stronger (SG+)	Yellow (Y)	Students describe the object, by referring to their own experiences, views, or perceptions of social conditions.

The student papers in the subjects of history and geography where coded with regards to their semantic strength and placed into three levels, red, green, and yellow. These levels are related to theory, concepts and facts as well as the students' own views. As a result, the study found considerable differences in the semantic profiles between the handed-in student papers in history and geography[28]:

[26] E. Bratland, (2018). *Tecnology and education: Why do students still need access to specialized knowledge?* In E. Baron-Polańczyk (Ed.), ICT in educatinal design (Vol. 12, pp. 37-49): Zielona Góra University Press.
[27] E. Bratland, (2018). *Technology and education: Why do students still need access to specialized knowledge?* In E. Baron-Polańczyk (Ed.), ICT in educational design (Vol. 12, pp. 37-49): Zielona Góra University Press, p. 43.
[28] E. Bratland, (2018). *Technology and education: Why do students still need access to specialized knowledge?* In E. Baron-Polańczyk (Ed.), ICT in educational design (Vol. 12, pp. 37-49): Zielona Góra University Press, p. 45.

Figure 2. Profiles of semantic gravity in student papers in history and geography (without pedagogy)



As mentioned, social sciences in teacher education have a knowledge code, implying that the epistemic relation to knowledge are stronger than the social ones. However, cumulative knowledge building, which in this example is limited to history, requires a special kind of cultivated gaze. Not all forms of cultivation lead to cumulative knowledge building in the social sciences. In geography, a one-sided focus on student exploratory learning has led to fact-oriented student papers. Here facts about the persecution of Norwegian minorities mainly before WWII, which students largely found online, is the legitimate version of knowledge in social sciences. This form of learning, which today typically takes the form of student-active exploratory forms of learning, is driven by the idea that the social world is accessible through Wikipedia and corresponding websites. In the majority of student papers, these facts are not linked to theories that could explain those facts and allow an independent assessment. This leads to a *semantic flatline* where the student texts repeat isolated facts, which then leads to segmented knowledge building' with very limited options for progression and a deeper understanding of the social world.

In history, the situation is very different; here the majority of student papers contain theories, facts, and individual assessment. In history, the students' dispositions have been cultivated, creating a development that allows students to distinguish between the mentioned three levels and at the same time establishes connections between those levels in the papers. This leads to texts that are characterized by *long semantic waves*. In these student papers the concept of sustainable development is used to explain and analyze data that in many cases were found on the UN climate panel about the climatic conditions on our planet. Several of the papers contain individual assessments of sustainable development focusing on measures and actions that are required to meet this threat. In contrast to geography, the history papers focus on theories and concepts explaining the data used in the tasks. This opens up the opportunity for progression and cumulative knowledge building. Here students' use of theory and concepts have a context transgressing character, resulting in a deeper understanding.

The two examples above, with their semantic analysis of student papers in history and geography show two different versions of progression with cultivated gazes in the social sciences. In geography this cultivation manifests itself in the search for facts that are unknown for the students, while the papers in history relate theories with the aim to understand and explain. Of the two forms of cultivated gazes only the history papers open up a space for progression and deeper understanding. Nevertheless, the cultivation that is expressed in the history papers is formed by a development where the cultivated gaze in the subject has limitations, where different theories are not evaluated against each other, which must be characterized as an incomplete fulfillment of the principle of explanatory coherence. This principle assumes a quest for the best explanation of a given case, a principle that according to Bereiter & Scardamalia[29] lead to theory development and progression in the social sciences. According to this program, there will be need for new form of development with a cultivated gaze in the social sciences. As stated by Bernstein (2000), the question is how social sciences can develop a structure with a strong grammar, theory development, and cumulative knowledge building.

Knowledge building as theory development in education

In education, knowledge building as theory development will have a different character than knowledge building in research where student learning activities typically will focus on investigation and on the development of concepts and theories. The aim of knowledge building in education is not primarily to push the scientific frontier but to develop a deeper understanding of the world. However, knowledge building in the classroom cannot deliver the standards required from theory development in science, but Bereiter and Scardamalia[30] argue that students can build *quasi-theories*: "Typically their creations fall short of yielding testable predictions, but good student-generated theories are vulnerable to evidence, improvable and discussable in terms of what they explain and fail to explain." Even though student theories are different from the theories of science, Bereiter and Scardamalia (2012) argue that these theories can meet the demands of explanatory coherence. As my example from social sciences in teacher education above shows, this is not an easy task, and it will require development of a new form of scientific literacy in education. While in geography the papers are marked by a fact-driven presentation without explanation, in history there are explanations however lacking a search for the best explanation, which limits knowledge building as theory development. The search for the best explanation requires a good overview of relevant theories and concepts in the social sciences. The next problem has already

[29] C. Bereiter, M. Scardamalia, (2012). *Theory building and the pursuit of understanding in history, social studies, and literature.* In J. R. Kirby & M. J. Lawson (Eds.), Enhancing the quality of learning : dispositions, instruction, and learning processes (pp. 160-177).

[30] C. Bereiter, M. Scardamalia, (2010). *Can Children Really Create Knowledge? Canadian Journal of Learning and Technology,* 36(1). Retrieved December 3, 2018, at http://www.cjlt.ca/index.php/cjlt/article/view/26377, p. 7.

been mentioned, the question of how one can make different social science theories compatible so that they can relate to each other and to accepted facts or data in the same way. Bernstein idea of a strong grammar has been the guiding principle, necessary for meeting the demands of explanatory coherence, which possibly can be realized by developing science literacy among students in the social sciences. The cultivation of students by developing their scientific literacy requires a process that over time enables students of the social sciences to meet the standards of strong grammar and of explanatory coherence. According to Chuy[31], there are three main problems that students need to understand in order to provide better explanations of the world. These problems, which are related to different levels in the forming of scientific literacy, includes the following elements:

1. The differentiation between theories and facts. Theories are not facts, theories explain facts.
2. The development of theories depends on an evaluation of their explanatory strength. Some theories are better than other theories because they explain the facts better, explain more facts, etc.
3. Explanations are linked to ideas. Ideas form the core of each theory. Ideas are decisive for new discoveries and for creating new knowledge.

As the example from my own study has shown, it is demanding to develop scientific literacy that enables students to be engaged in these problems with the aim to develop theories and better explanations of accepted facts in the classroom. The development of scientific literacy is demanding, not at least in an educational system marked by segmentalism and by context dependent forms of knowledge; however it is not an impossible task. Knowledge building as theory development in the classroom can provide students with a much deeper understanding in comparison with traditional classroom teaching. To study whether knowledge building really leads to a deeper understanding, Chuy and her colleagues conducted a landmark study comparing two classes of school students in Canada[32]. This study was formed as a natural experiment with an experimental and a traditional class that for a duration of four months experienced two different pedagogical approaches. In the experimental class teaching focused on knowledge building following Scardamalia and Bereiter's principles (2006, 2010), while in the control group student-active projects were conducted with a focus on explorative methods within a constructivist framework. To study the degree of comprehension or in-depth learning, all participants were interviewed twice; first at the beginning of the study and then again four months later at its end. The data from the study were compared and analyzed in relation to a set with chosen categories (nature of

[31] M. Chuy, M. Scardamalia, C. Bereiter, F. Prinsen, M. Resendes, R. Messina, A. Chow, A. (2010). *Understanding the Nature of Science and Scientific Progress: A Theory-Building Approach. Canadian Journal of Learning and Technology,* 36(1). doi:10.21432/T2GP4R. Retrieved December 3, 2018, at http://www.cjlt.ca/index.php/cjlt/article/view/26373, p. 5-6.

[32] M. Chuy, M. Scardamalia, C. Bereiter, F. Prinsen, M. Resendes, R. Messina, A. Chow, A. (2010). *Understanding the Nature of Science and Scientific Progress: A Theory-Building Approach. Canadian Journal of Learning and Technology,* 36(1). doi:10.21432/T2GP4R. Retrieved December 3, 2018, at http://www.cjlt.ca/index.php/cjlt/article/view/26373.

theoretical progress, theory-fact understanding, role of ideas in scientific inquiry and invention). Not surprisingly, the study confirmed that students understanding of scientific development and knowledge, scientific literacy, was considerably higher in the knowledge building class in comparison with the control group. The authors of this study explain the difference and conclude[33]:

"Thus we are left with technologically supported Knowledge Building as the most plausible explanation of the higher levels of scientific literacy shown by the experimental group. With extended immersion in a Knowledge building environment, nine and ten-year-old girls were able to understand that the goal of science is to improve available explanations of phenomena, rather than accumulate a certain number of facts."

This study shows that knowledge building with a focus on theories and ideas rather than on facts or skills can lead to scientific literacy among students already in primary school. Knowledge building as theory development enables students to understand why theories are so important for scientific development and allow students to transgress traditional forms of learning in schools providing them with the tools to construct a deeper understanding of the world[34]. With knowledge building, education becomes something more than to learn a set of facts or skills, and students become agents of discovery processes that were driven by themselves and had the aim to find the best explanation of given phenomena expressed through accepted facts.

Knowledge building as theory development promotes scientific literacy, in this process students are enabled to distinguish between theories and facts and can address the complex problems that Bernstein[35] describes, leading to a situation that different theories can be treated with a degree of compatibility and be related to the same set of data or established facts. The digitalization of education provides simple access to current research and accepted facts, providing opportunity for students to work with theories and concepts that can enable them to identify the best explanation of these facts. This approach, with a focus on the theories and concepts of social sciences, allows cumulative forms of knowledge building where the students' knowledge building has a context-transcending character. Under such conditions, segmental and context-based forms of learning can be overcome by building knowledge that will have validity across time and contexts.

[33] M. Chuy, M. Scardamalia, C. Bereiter, F. Prinsen, M. Resendes, R. Messina, A. Chow, A. (2010). *Understanding the Nature of Science and Scientific Progress: A Theory-Building Approach.* Canadian Journal of Learning and Technology, 36(1). doi:10.21432/T2GP4R. Retrieved December 3, 2018, at http://www.cjlt.ca/index.php/cjlt/article/view/26373, p. 17.

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Conclusion

Knowledge building as theory development is a relatively new idea in education. This paper relates this idea to the Norwegian curricular reform (LK20) which introduces understanding and in-depth learning as important categories in education (Bratland 2019). Knowledge building with the aim of deeper understanding in school is often associated with the natural sciences, which emphasize the development of theories that can explain a greater number of phenomena, developing hierarchical knowledge structures, and integrating various theories. The object of the social sciences and its forms of knowledge are different from the natural sciences with a different knowledge structures providing different conditions for knowledge development in the subject. Although the social sciences are different from the natural sciences, this paper argues that progression and deeper understanding are achievable in the social sciences, under certain conditions. According to Bereiter and Scardamalia's (2012), knowledge building in society is typically characterized by theories that can explain particular cases, which distinguishes social sciences from the natural sciences. Bereiter and Scardamalia claim that theory development nevertheless can be based on the principle of explanatory coherence, based on the search for the best explanation. This paper discusses this requirement in the light of Bernstein's (2000) theory that characterizes the social sciences as a subject with a horizontal knowledge structure with a weak grammar.

This term, which provides several apt descriptions of problems linked to theory development in the subject of social sciences, led Bernstein to a pessimistic conclusion about the possibilities for progression and cumulative knowledge building in the social sciences. I argue for a different position, one that Bernstein characterizes as strong grammar, which provides an opportunity for cumulative knowledge building. Based on social realism, this paper presents a proposal to revise and to expand Bereiter and Scardamalia's (2012) theory about knowledge building in education. With a starting point in Bernstein (2000) and Maton (2014) and with the contributions of my own and others' research, this paper identifies some of the conditions for cumulative knowledge building in the social sciences. Knowledge building as theory development in the social sciences requires its own trajectory where students can develop theories under the principle of the best explanation for a particular case. In order to explain facts better, it must be possible to relate different social sciences theories to the same set of facts or data, providing the opportunity to create links between theories and accepted facts or data. This is not an easy task, but there is promising research indicating that students by cultivating early in their educational career can develop a form of scientific literacy enabling them to build cumulative knowledge in education. By focusing on the theories and concepts and by using the theories in a creative and adaptive mode, related to accepted facts or data, students can overcome segmentalism and build knowledge that can be transferred to new contexts, which is a prerequisite for in-depth learning and progression in the subject of social sciences.

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Erik Bratland

Knowledge building as theory development in education: What forms of progression and in-depth learning are possible in the subject of social sciences?

The new Norwegian curricular reform (LK 20) implies a return to comprehension-oriented teaching and in-depth learning with focus on the theories and concepts of the subjects. However, it is not clear how in-depth learning can be achieved in education, and in which way a deeper understanding and progression can be realized in the social sciences. This problem, described as a lack of progression or knowledge growth in the social sciences, can, according to Bereiter and Scardamalia, be overcome, by an approach that emphasizes knowledge building as theory development in education. Based on social realism, this paper discusses which forms of knowledge building and progression that are possible in the subject of social sciences.

Keywords: social realism, Bernstein, in-depth learning, knowledge building as theory development, social sciences, progression, cultivation.

Budowanie wiedzy jako rozwój teorii w edukacji: Jakie formy progresji i pogłębionego uczenia się są możliwe w dziedzinie nauk społecznych?

Nowa norweska reforma programów nauczania (LK 20) zakłada powrót do nauczania zorientowanego na zrozumienie i pogłębione uczenie się z naciskiem na teorie i koncepcje przedmiotów. Nie jest jednak jasne, w jaki sposób można osiągnąć pogłębione uczenie się w edukacji i w jaki sposób można osiągnąć głębsze zrozumienie i postęp w naukach społecznych. Problem ten, opisany jako brak postępu lub wzrostu wiedzy w naukach społecznych, może być, według Bereitera i Scardamalii, przezwyciężony przez podejście, które kładzie nacisk na budowanie wiedzy jako rozwój teorii w edukacji. Bazując na realizmie społecznym, w niniejszym artykule omówiono, które formy budowania wiedzy i postępu są możliwe do osiągnięcia w dziedzinie nauk społecznych.

Słowa kluczowe: realizm społeczny, Bernstein, pogłębione uczenie się, budowanie wiedzy jako rozwój teorii, nauki społeczne, postęp, kultywowanie.

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