



# Educational Neuroscience and Reconsideration of Educational Research

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**Abstract:** *Educational neuroscience is a cross-disciplinary field where researchers work at the interface of education, psychology, and cognitive neuroscience. Certain difficulties arise in the merging of the disciplines as a result of differences in the traditions' philosophies, methodologies, theories, and practices. Critical consideration of the 'bridging project' is essential for the development of educational neuroscience, but I will also argue that questions arising in the wake of this cross-discipline are relevant for reconsidering educational research.*

**Keywords:** *educational research, educational neuroscience, reconsideration, transdisciplinary research.*

## INTRODUCTION

The novel field of *educational neuroscience* has experienced considerable growth and expansion internationally in recent decades. Starting as pioneering research collaborations between disciplines and sub-disciplines of education, psychology, and neuroscience, the field is now well established – annual conferences are held around the world, there is a growing body of educational neuroscientific literature, and master's and doctoral programmes in educational neuroscience have been established at universities such as Harvard, Oxford, and Cambridge<sup>1</sup>.

Educational neuroscientific research initiatives focus on possible connections between biological, neuroscientific, psychological, educational, and sociological perspectives on matters such as learning, emotion, and cognitive development. However, these endeavours bring certain research issues to the surface, as attempts are made to link different disciplinary traditions. How, for example, should one understand 'learning' in this collaboration, when the research traditions have different definitions of the concept? How does the philosophy of natural sciences (viz. neuroscience) concur with the philosophy of social sciences (viz. education)?

<sup>1</sup> Certain principles and structures are still not firmly established within the field – such as the field's *name*. Disciplinary titles range from 'educational neuroscience' (Campbell, 2011) 'mind, brain, and education' (Stein & Fischer, 2011), and 'neuroeducational research' (Howard-Jones, 2010) to 'pedagogical neuroscience' (Fawcett & Nicolson, 2007). For the sake of consistency, in this paper I will use the title 'educational neuroscience'.



And is there a shared research aim in this multifaceted discipline? The educational neuroscientific community has invested much time in discussing these and similar questions, as actors from different fields present their take on how to bridge ‘the gap’ between education and neuroscience. Accordingly, certain core principles in each research tradition are set against each other and reconsidered, and attempts are made to merge them.

The bridging project of educational neuroscience offers an interesting case of cross-disciplinary examination. In this review paper I will, by the use of perspectives derived from critical discourse analysis, present some issues and possibilities in the discipline. I will also argue that questions arising from this novel field can be seen to provoke particular re-evaluations of educational research, and these topics are worth discussing further.

## A CRITICAL DISCOURSE ANALYSIS OF EDUCATIONAL NEUROSCIENCE

This review paper is based on my recent study of educational neuroscience, where I used Norman Fairclough’s critical discourse analysis framework in order to investigate the development and impact of educational neuroscience as a *discourse* (Flobakk, 2015). In this research I examined the *emergence* of the academic level of educational neuroscience, as well as different *hegemonic relations* therein. Attention was also paid to the field’s impact outside academia; that is, how the academic discourse of educational neuroscience is re-

*contextualised* to other fields, such as political and public fields.

When it comes to Fairclough’s critical discourse analysis (CDA), the focus is on *critical* aspects as emphasis is given to “opaque relationships of causality” between discursive texts, events, and practices on the one hand, and wider social and cultural structures, processes, and relations on the other (Fairclough, 2010, p. 93). The identification of such discursive structures is based on the idea that *text* (spoken or written language) must be seen as part of a social event shaped by both social agents and by discursive and social structures and practices. Systematic analysis of text is therefore essential because it can reveal: i) the network of practices wherein a text is located, ii) the relationships between semiosis and other elements within the practice, and iii) the discourse itself (Fairclough, 2003).

Seeing that a discourse study is dependent on the texts selected for the final analysis, systematic and ample search criteria are important for its reliability. For my research it was, for instance, essential to ensure that the selected literature represents a justifiable repertoire of texts relevant to the educational neuroscience discourse. By following the principles of critical discourse analysis (Fairclough, 2003, 2010) and classic and systematic literature search procedures (Hart, 2001; Jesson, Matheson, & Lacey, 2011), as well as research specific criteria, over 13.000 texts were screened. A four-step selection procedure was subsequently used – each with more exhaustive readings and selec-



tion criteria – reducing the literature to a corpus of 111 texts for the final discourse analysis. The texts are mainly international academic articles on educational neuroscience, but relevant political and public texts are also included. They were mostly published during the later and more contemporary phases of the educational neuroscience discourse (i.e. from the 1990s to the present day), and they were chosen in order to reflect different views and different levels of the discourse.<sup>2</sup>

Considering that my recent critical discourse study provides systematic analysis of the educational neuroscience discourse, it makes a good foundation for this review paper. The review is consequently based on the (rather extensive) body of literature from the overarching *discourse* of educational neuroscience, rather than a few particular texts on educational neuroscience. This is of note, since it is not each individual text *per se* that is interesting in this review, but rather the comprehensive picture of the educational neuroscience discourse that they make together. Moreover, the review will only include findings relevant to the topic of educational neuroscience, its treatment, and how it can be related to a reconsideration of educational research.

It should also be noted that educational neuroscience does not consist of a coherent group of actors with similar opinions, values, academic backgrounds, and so on. On the academic level one

can find educationists, psychologists, and neuroscientists; one can also find theoretical researchers and practitioners such as teachers and school staff. Even if these actors have an interest in educational neuroscience, their approaches to the field may vary. Actors from different groups may take different approaches, but so can actors within the same group. In my earlier research (Flobakk, 2015) I mapped out discursive alignments in educational neuroscience, as well as central hegemonic relations within and between these groups. The findings show that there are larger percentages of theoretical researchers in educational neuroscientific debates than practitioners such as teachers and school staff. The findings also indicate that certain topics, or certain areas, are dominated by cognitive scientists while educational researchers linger in the background.<sup>3</sup> Nevertheless, some perspectives are more commonly expressed across the educational neuroscience discourse than others – particularly those in line with a *cautious approach* to the field – and some of these views are displayed in this review. The reader should nevertheless bear in mind that groups with different views exist within, and outside, the educational neuroscience discipline.

## EDUCATIONAL NEUROSCIENCE

Educational neuroscientific research interlinks aspects of the brain, the mind,

<sup>2</sup> See ‘*The development and impact of educational neuroscience*’ (Flobakk, 2015) for detailed descriptions of my search procedure, criteria for resource inclusion, analytical procedures, and reference list for the corpora.

<sup>3</sup> For example, educational neuroscientific debates in Norway appear to be dominated by neuroscientists.



and education – often with the aim of enhancing our understanding of learning, cognition, and development. Examples are studies on the role of mirror-neurons in our ability to learn from observing others (Jong, Gog, Jenks et al., 2009), the influence of emotions on cognition (Patten, 2011), and aspects related to difficulties such as dyslexia, dyscalculia, and ADHD (Fredrickson & Cline, 2009). Even if many researchers study practical aspects related to education and neuroscience, it is important not to overlook the *different levels of research* these endeavours encompass. Cross-disciplinary undertakings are complex and challenging, because different academic traditions often operate with different vocabularies, concepts, methods, and theories, and sometimes even contrasting values, aims, and philosophies. Important questions are brought to the surface in the attempt to combine diverse (and sometimes deep-rooted) scientific ‘knowledge’, and the educational neuroscientific community frequently discusses the issues – and possibilities – that emerge from their work (as can be seen in Howard-Jones, 2008; Samuels, 2009; Stein, Connell, & Gardner, 2009; Varma, McCandliss & Schwartz, 2008).

### **Disciplinary Difficulties in Educational Neuroscience**

Some disciplinary difficulties in educational neuroscience arise as a result of different *philosophical perspectives*. For instance, Samuels (2009) notes that, on the one hand, there is cognitive neuroscience,

where the most common epistemologies are empiricism and realism. In these philosophical stands one often considers knowledge to come from what can be perceived, and ‘knowledge’ is therefore connected to the idea that reality can be observed through empirical investigations. On the other hand, we have education and epistemologies that are more in line with rationalistic and relativistic perspectives. The current and prevalent epistemic stance here is said to be constructivism, and common conceptualisations of knowledge are related to the idea that “reality is socially constructed” and “knowledge comes from what can be thought about” (Samuels, 2009, p. 48). Education and neuroscience can therefore be seen as being built on some fundamental different philosophical premises, often distinguished by the ‘classic divide’ between the natural sciences and the social sciences.

Different philosophies of science are further manifested in different *theories* and *methodologies* across the ‘borderlines’ of education and neuroscience. Cognitive neuroscientists often take a natural scientific approach with biological, cognitive, and neuropsychological perspectives. Methods are related to empirical and technical experiments, as well as the analysis of brain structures and functions (Gazzaniga, Ivry, & Magun, 2009). On the other side, educational studies strive to encompass the complexity of the social, often through the use of sociological, philosophical, developmental, and socio-political perspectives. These theoretical and methodological variations are par-



ticularly evident in the different research approaches taken by neuroscientists and educationists. For example, when it comes to the topic of learning and strong emotions such as stress, a neuroscientist may focus on how chronic stress can disrupt the regulation of glucocorticoid secretion at the micro-biological level of the brain, and how this in turn may impair the performance of the hippocampal memory system (Sapolsky, 1992). An educationist, on the other hand, may be more interested in understanding environmental and stressful factors in the child's life (such as violence in the family), which in turn can impede the child's ability to pay attention to learning activities in other settings (D'aurora & Fimian, 1988).

In light of the different levels of research between the brain, mind, and education, it is not surprising that educational neuroscientists also experience difficulties with *terminology*. In order to exemplify this, let us look at the concept of 'learning'. Howard-Jones (2008, p. 362) elaborates upon this perspective and notes that "in neuroscience, the term 'learning', when used as a noun, is often synonymous with 'memory'". At the same time, learning is often associated with the declarative memory system and with how the hippocampus operates in the process of forming and recalling memories. In addition to declarative memory, other essential concepts related to learning are working memory, synaptic plasticity, structural changes in the brain, and accompanying functional correlations in, for instance, biological activity. Neuroscientists therefore mainly

consider 'learning' in terms of changes in an individual's biological system (Howard-Jones, 2008, 2010), and the methods used to acquire knowledge about learning are often related to empirical and technical experiments and analysis of brain structures and brain functions – such as measurements of metabolic and electrical activity in the brain (e.g. PET scans and EEG) (Gazzaniga et al., 2009).

Educationists comprehend 'learning' differently. Instead of looking at biological changes at the cellular and structural levels of the brain, they often focus on more social aspects of learning. Educational approaches to learning are thus more consistent with the "holistic development of the person in society" (Samuels, 2009, p. 48), where multifaceted approaches are taken – for example, socio-political and intergovernmental approaches (Green, 2006; Rizvi & Lingard, 2006), developmental approaches (e.g. Piaget, 1964), sociological approaches (e.g. Bernstein, 2000; Bourdieu, 1986), or sociocultural approaches (e.g. Vygotsky, 1978). Again, disciplinary variations in educational neuroscience seem prone to causing research issues, since even the understanding of essential concepts such as 'learning' differs between the two traditions.

Perhaps more subtle, but just as significant, are disciplinary differences in *research aims, agendas, and values* between education and neuroscience. Because how do researchers from the different traditions understand the *aim* of educational neuroscience? Which values, ideologies, and ethics are assumed to be essential for



the field? Is the aim of educational neuroscientific research to make educational practice more efficient, or is it to provide new insights into the complex process of learning? In this respect it is often noted that neuroscientists come from a tradition of the ‘hard’ sciences, seeking explanations and considering what we *can do*. In contrast, the ‘softer’ field of education is more inclined to ethical and evaluative reflections on social matters, seeking understandings and contemplating what we *should do*. In questions concerning the field’s aims and values, many educationists thus find it essential to ask “what learning and education *ought to be*”, rather than asking “what learning and education *actually is*” (Emmeche & Schilhab, 2007; Varma et al., 2008).

It is evident that education and neuroscience, in their extreme forms hold contrasting research premises and thus it is almost inevitable for research issues to occur in the endeavour to ‘bridge the gap’ between the two. The question that ensues, though, is *how* the educational neuroscientific community attempts to resolve these difficulties.

### Cross-Disciplinary Possibilities

The argument for linking education and neuroscience is grounded in the idea that cross-disciplinary approaches can be beneficial. Seeing that education, psychology, and cognitive neuroscience study areas such as learning, language processing, emotions, and cognitive development, attempts are made to integrate their differ-

ent disciplinary knowledge bodies in order to create more holistic understandings of the matters under investigation. However, and as noted above, the traditions have certain deep-rooted disciplinary differences, as they approach research matters at different levels of analysis. Instead of shying away from one another, though, a central tenet in the educational neuroscientific research community is reciprocal and anti-reductionist collaboration (as can be seen in Ansari & Coch, 2006; Fischer et al., 2007; Geake & Cooper, 2003; Goswami, 2006; Howard-Jones, 2010; Petitto & Dunbar, 2004; Varma et al., 2008). In order to achieve this, much attention is paid to the ‘bridging project’ connecting neuroscience and education. Questions emerging from their cross-disciplinary work are discussed, disciplinary differences are addressed, philosophical issues are debated, and attempts are made to see theoretical and methodological problems in a new light.

By drawing on critical discourse theories on boundary transgression and change (cf. Fairclough, 2010), one can say that the development of educational neuroscience follows a route of the problematisation of time-honoured disciplinary divides, transgression and crossing of borderlines, and re-articulation of discursive aspects to new disciplinary knowledge (Flobakk, 2015). For instance, relations between the brain, mind, behaviour, and the education are reviewed and, concurrently, neuroscientific, psychological, and educational principles are also reconsidered. The aim is *not*, as some believe, to exchange edu-



cational perspectives for ‘new and better’ neuroscientific theories. Rather, a common goal in educational neuroscience is to propose new perspectives on, for instance, learning, which makes allowance for complex and interactive relations between the level of the brain, the mind, and education (Ansari & Coch, 2006; Howard-Jones, 2010; Varma et al., 2008). Hence it is stressed that cognitive sciences can contribute with new understandings of educational matters (e.g. biological aspects on learning), whereas education can contribute with new perspectives on cognitive matters (e.g. social and environmental aspects of learning).

“Education is not neuroscience, and neuroscience is not education. Each discipline addresses a broad range of research questions using a variety of methods. The challenge is to identify the questions and methods that usefully overlap. At present, neuroscience has little to say about the social construction of inequity, and education has little to say about the hemodynamic response function. Educational neuroscience will need to mind these and other gaps – but it need not be defined by them” (Varma et al., 2008, p. 150).

An example illustrating the cross-disciplinary and anti-reductionist approach of educational neuroscience is the view on the nature-nurture dichotomy. The debate on nature as opposed to nurture – or, if you like, biology vs. environment, genes vs. experience – is a relatively old negotiation of different basic viewpoints between the natural sciences and the social sciences. Even if the nature-nurture debate

is still highly contentious, and in some areas not settled, many educational neuroscientists have moved away from viewing this as a strict ‘either-or’ struggle (as can be seen in Gelman & Taylor, 2010; Howard-Jones, 2010; Logan & Johnston, 2007; Stein & Fischer, 2011). Moderation of the previously irreconcilable difference is often made as authors take a ‘nature *and* nurture’ perspective, where both biological and environmental accounts are taken into consideration when explaining a complex phenomenon such as learning. This does not mean that one *cannot* study learning just by the use of environmental perspectives or just by the use of biological perspectives – this is possible, and often advantageous, depending on which level of analysis one pays attention to. One should, however, be careful not to reduce the phenomenon to simple ‘either-or’ explanations, as this rules out possibilities of complex and bi-directional interplay between biological, sociological, psychological, and educational perspectives on learning.

“A seductive temptation in building MBE [mind, brain, and education] is *reductionism* in analyzing phenomena that are studied at several levels of analysis or from different basic viewpoints. The tendency to offer unidimensional solutions to multidimensional problems is great – discussing a multilevel issue as if it can be reduced to one level, or treating a multi-viewpoint issue as if one viewpoint is essential and the other can be omitted or neglected. For example, the press commonly present findings from



biological methods, such as genetics and neuroscience, as if they involve ‘harder’, more substantial, more scientific knowledge – privileged relative to psychological and cultural methods, which are marginalized as ‘soft’, needing to be reduced to biological ‘causes’” (Stein & Fischer, 2011, p. 59).

A more practical example of the interlinkage of neuroscience and education can be seen in studies on sleep and learning. Neuroscientific studies are beginning to reveal the process sleep has in memory consolidation (Maquet et al., 2000), and how sleep helps us prepare to learn more and use what we know to generate insight (Wagner et al., 2004). Studies also show how teenagers, because of changes in their biological rhythms, experience a shift and delay in daily sleep patterns, making it difficult for them to go to sleep and get up early (SCNi, 2016). These findings show that regular and sufficient sleep is essential for our ability to learn efficiently, and how there appears to be an adolescent circadian delay in sleep. Concurrently, educational neuroscientific research is conducted in order to investigate the effect of a delayed start time in high schools and the impact this can have on teenagers’ learning (SCNi, 2016). Other examples are studies where neuroscientific insight and educational knowledge are used in order to proffer new perspectives on reading abilities, the early acquisition of numbers, and the effect of stress on memory. Researchers have also linked scientific brain studies on exercise, the intake of caffeine, and ‘developmental

disorders’ such as dyslexia and dyscalculia with educational perspectives (Howard-Jones, 2010).

Again, it is important to stress that most of these educational neuroscientific studies do not refute ‘old’ educational theories. In fact, we often find that new insights from the cognitive sciences coincide with educational theories, thus contributing with biological explanations to educational and social accounts. Nevertheless, research on the linkage between education, psychology, and neuroscience is still in its infancy, and there is yet much to discover. The majority of educational neuroscientists thus appear to be cautious when working across the different levels of analysis, and they are particularly hesitant about drawing links from educational neuroscientific *theory* to implications relevant for educational *practice* (Christodoulou & Gaab, 2009; Dekker, Lee, Howard-Jones & Jolles, 2012; Hook & Farah, 2013). In fact, it is stressed that there is currently no comprehensive body of educational neuroscientific practice, and nor are there any teaching strategies or intervention tools which can be used directly in classrooms (Simmonds, 2014). Yet again, this bears witness to the complexity of educational neuroscientific work, as attempts are made to interlink different levels of analysis – whether educational/neuroscientific or practical/theoretical. However, these ‘gaps’ do not mean that neuroscience and education *cannot* be interlinked, nor do they imply that one can uncritically transfer neuroscientific research to educational practice. It is instead argued that one must be careful





in itself, provide insights into difficulties and possibilities as to *how* one can unite different disciplines and *how* one can structure a new emerging field. For instance, the educational neuroscience community has experienced the importance of good communication in cross-disciplinary work, and also how one should strive to include different parties in reciprocal dialogue. This is because difficulties appear to arise when communication between different actors is imprecise or, worse still, if dialogue is lacking altogether. Typically, this is seen when research is *misinterpreted* and *misrepresented* when transferred across different levels of analysis by different actors – either between researchers themselves, or between researchers and actors outside academia.

In order to reduce misinterpretations and misrepresentations between researchers *within* the academic level of educational neuroscience, it is important that academics examine their research critically in order to provide accessible and valid information (Flobakk, 2015; Howard-Jones, 2010). This means that experts on education, psychology, or neuroscience should make visible how concepts are understood and their use of theories, methods, and philosophical grounding, as well as clarifying any current limitations in their study, so that actors with other disciplinary backgrounds can evaluate and make use of this research. The field has, moreover, recognised that collaboration between educationists and neuroscientists is most beneficial when cautious and anti-

reductionist approaches are taken. References are often made to transdisciplinary principles (Beauchamp & Beauchamp, 2013; della Chiesa, Christoph, & Hinton, 2009; Samuels, 2009), where educational neuroscience is perceived as a *new* discipline emerging from a field of prior discourses and *not* as a subdivision grounded in either cognitive neuroscience or in education.

“[B]ridging the divide that separates the education and neuroscience *disciplines* requires bridging the divide that separates the education and neuroscience *communities* ... [W]e should remain cautious in our optimism. Education research and neuroscience can inform each other, but within limits, which we have yet to discover ... [A] strategy is for education researchers and neuroscientists to view themselves as collaborators, not competitors, in the pursuit of knowledge. This requires a commitment to working together” (Varma et al., 2008 p. 149).

Even if some misinterpretations occur within academia, the most common misinterpretations transpire between researchers and actors *outside* academia. These misrepresentations are often seen when educational neuroscientific research is transferred from the academic level to the political or public levels (Flobakk, 2015). Some prime examples are the numerous neuromyths and edumyths presented in the media and in the so-called ‘brain-based’ learning industry<sup>4</sup> – often seen in attention-grabbing headlines such as “a cup of cocoa before bedtime boosts

<sup>4</sup> The term ‘*Brain-based*’ education describes the commercialised learning industry that sells learning programmes claimed to be grounded in brain science. The educational neuroscientific community warns against such products, because the ‘scientific grounding’ is often misinterpreted and/or based upon neuromyths.



your IQ” (Wighton, 2007) and “10 fun ways to boost your child’s brain power” (Carlyle, 2014). Misrepresentations like these seem to occur when actors outside academia use too-hasty conclusions from educational neuroscientific research as the basis for practical recommendations – *without* conferring with researchers. This leads to difficulties, because misrepresentations spread by public actors hinder the (more cautious) messages sent out by the scientific community.

“[A]t present, teachers are at the receiving end of numerous ‘brain based learning’ packages. Some of these contain alarming amounts of misinformation ... These neuromyths need to be eliminated. The dominance of these myths obscures the important strides being made by cognitive neuroscience in many areas relevant to education” (Goswami, 2006, pp. 2-3).

Reciprocal communication may reduce inconsistencies in translation between different levels of the educational neuroscience discourse. Not only can dialogue between academics and the political and public fields reduce misinterpretations of educational neuroscientific research; better dialogue can also provide more public information and initiate critical readings of, and careful approaches to, the enthralling and “brain-boosting” learning programmes. This underlines the importance of good communication in cross-disciplinary work, and also how one should strive to include different parties in reciprocal dialogue – whether this is dialogue between neuroscientists and educationists, or between theorists, practitioners, policymakers, and public actors.

## Disciplinary Knowledge

Apart from providing insights into the building of cross-disciplinary constructs, I will argue that educational neuroscience is relevant because of its disciplinary knowledge. As we have seen, negotiation takes centre stage in the integration of disciplinary perspectives, as old questions are brought back into the spotlight and emerging research issues are acknowledged, addressed, and reassessed. These negotiations are essential for the development of educational neuroscience, but they can also be of relevance for reconsidering educational research. For instance, reassessment of the relations between brain, mind, behaviour, and the education can be of note to educational researchers, since an emphasis on bi-directional links opens up more holistic perspectives on complex processes such as learning, emotions, and development.

Again we touch upon the form of the explanations one aspires to in the ‘nature-nurture’ impasse. In this respect it is important to stress that many social scientists and educationists acknowledge that learning and development are caused by *both* nature *and* nurture. However, and interestingly enough, many nevertheless choose to focus on nurture only (Kennair, 2008). Indeed, several questions in the social sciences should be answered by social and environmental explanations alone, because biological approaches are irrelevant in particular matters. For example, biological approaches will add little or nothing to questions concerning how teachers evalu-



ate the school-home dialogue, or how educational practice and policies have changed from the 19<sup>th</sup> to the 21<sup>st</sup> century. However, there are many other social and educational studies which *can* benefit by including biological perspectives. This is particularly relevant for research concerned with topics at the interface of different levels of analysis. For instance, both neuroscientific and educational perspectives can be appropriate when investigating different reading methods, since educational theories on reading strategies may be complemented with neuroscientific theories on letter and phonological processing in the brain. The crucial point is to acknowledge that different research questions can, and *should*, be asked at different levels, and that these levels cannot be reduced to one another. Neuroscientific perspectives have value by providing insights into micro-biological aspects in the brain, whereas educational research has value by providing insights into macro individual-social phenomena. Neither education, nor neuroscience, provides final and objective truths and neither should be seen as giving more significant explanations than the other.

Following this, one can ask whether or not neuroscientific perspectives contribute new and relevant inputs to educational matters, or, vice versa, if educational perspectives make any valuable contributions to the cognitive neuroscientific field. There are, as already mentioned, certain themes which, for instance, neuroscience *cannot* provide any relevant perspectives on – such as the way in which educational policies have changed during recent decades – sim-

ply because the research question is located at a different level of analysis than the one accessible to neuroscience. But what about the themes neuroscience does have access to, such as aspects related to development, emotions, cognitive deficits, and learning? How much difference do neuroscientific perspectives on ‘sleep’ and ‘stress’ – or ‘memory’ and ‘cognitive development’ for that matter – make to educational research in general? Seeing that neuroscience often seeks to explain general and biological aspects of the individual brain, then perhaps its perspectives are too crude for providing any valuable insights into the everyday and complex dealings of education? This also triggers discussions concerning what *expectations* we have concerning the linkage of education and neuroscience. Do we expect neuroscience (either now or in the future) to revolutionise the educational field, or do we expect the linkage of education and neuroscience to be more modest and dynamic in its interchange of perspectives?

Questions such as these are essential in the educational neuroscience debate, because they illuminate the differences and similarities between the prior research traditions. Furthermore, I will argue that these educational neuroscientific questions are valuable for reconsidering educational research: not only do they touch upon concrete research questions which should be seen in the light of different levels of analysis, but they also address fundamental questions in science by illuminating alterations in the time-honoured philosophical, theoretical, methodological, practical, and ethical gulfs between



the natural and the social sciences. Such debates can trigger discussions and re-evaluations of old and, perhaps, taken-for-granted premises in many research traditions – education being just one of them.

### EDUCATION – AN IMPORTANT COUNTERWEIGHT TO THE 'BRAIN-HYPE'

Educational researchers can benefit by participating in educational neuroscience debates where disciplinary knowledge is continually reconsidered, but the educational neuroscience community also has much to gain by getting more attention from educational researchers. Even if the field strives for reciprocal collaboration, studies show that much educational neuroscientific work is run by psychologists and cognitive neuroscientists, whereas educationists linger hesitantly in the background (Flobakk, 2015). Ironically, it has also been shown that educational practitioners often get swept off their feet by enthralling brain scientific explanations and, as a result, attribute excessive weight to 'brain facts' at the expense of educational theories (Weisberg et al., 2008; Dekker et al., 2012).

One can also find increased attention to neuroscience and education in the po-

litical field. In 1999 to 2007 the OECD led the project *Learning Sciences and Brain Research*, with the intention being to "encourage collaboration between learning sciences and brain research on the one hand, and researchers and policymakers on the other hand" (OECD, 2007, p. 3). Similar political projects are the American early learning and childcare projects *Head Start* and *Early Head Start* (US Department of Health & Human Services, 2014), and the UK TLRP initiative (2007). Research on the brain, cogitation, and learning has also attracted public interest and the 21<sup>st</sup> century has shown an upsurge in commercial 'brain-based' learning programmes, pop-scientific books, TV programmes, and media articles with titles such as "how to improve your brain" (e.g. Brain Gym, 2014; Carlyle, 2014; Learning Rx, 2014; Wighton, 2007). The weight attributed to neuroscientific explanations in comparison to educational explanations differs, but it appears that *the brain* has a fascinating appeal to academics and the public and it is consequently given most attention – a tendency nicknamed 'brain-hype' and 'neuromania' in the 21<sup>st</sup> century (Pasquinelli, 2011).<sup>6</sup>

The inclination of academics, policymakers, and the general public to pay attention to 'the brain' in aspects relevant

<sup>5</sup> It is interesting to ask *why* policymakers and public actors (as well as many academics) have jumped on the bandwagon, linking 'the brain' with aspects of 'learning' and 'education'. Findings from my critical discourse analysis (Flobakk, 2015) suggest that the current 'neuromania' can be ascribed to developments within the brain sciences, as new technologies make it possible to discover remarkable aspects of our brain. Another explanation can be linked to overarching trends in society and amongst policymakers – particularly with regard to the *neoliberal turn*. Thorough discussions concerning neoliberal undercurrents and how they affect the field's development (both within and outside academia), would, however, go beyond the scope of this paper.



to learning and education is of note. A focus on different levels of analysis is, as argued above, not necessarily a disadvantage. What is disquieting is the risk of top-down and reductionistic approaches if brain science is given a predominant role – for instance, if research on ‘the brain’ reduces the child to a set of functional and biological processes operating in a way that is detached from a larger societal context. It is, furthermore, distressing that there appears to be a lack of engagement by the wider educational community in these matters, particularly seeing that educational research may function as a counterweight to ‘brain-hype’ in aspects relevant to learning and schooling.

The educational neuroscientific community strives continually for reciprocal collaborations, but this means that educationists have to step into the arena and participate in debates. The educational field has accumulated a significant knowledge base on motivation, social interaction and communication, learning disorders, social inequality, teaching strategies, curricula designs, school organisations, and educational leadership. Cognitive neuroscientists therefore have much to gain by listening to educational theorists and practitioners, because their knowledge can point out perspectives which may not be obvious to cognitive scientists. Educational knowledge also brings valuable perspectives concerning ethical, evaluative, practical, and individually and socially beneficial aspects. Whereas neuroscientists and cognitive psychologists often bring new insights into how

we *can* organise educational practice, it is educators who can give indispensable insights regarding how we *should* organise educational practice. This vital difference between ‘what can be done’ and ‘what should be done’ does not depend solely on what science says is possible, but also on what in the long run is individually and socially beneficial. Overall, educational research offers a counterweight to neuroscientific aspects of learning and children’s development. Regardless of whether or not educational researchers agree with the idea of linking education and neuroscience, their knowledge provides indispensable perspectives in these debates.

### CONCLUDING REMARKS – CRITICAL CONSIDERATION

An important part of research is to continually seek answers to, and new perspectives on, scientific phenomena. This implies scrutinising the phenomenon itself (what, which context?), as well as evaluating the ways in which we seek to acquire knowledge of this phenomenon (how, why, which aim, and for what purpose?). What is more important, and definitely more challenging, is also to scrutinise the scientific structures we already take for granted; to question the unquestioned. Because do we perhaps follow some scientific premises – whether theoretical, methodological, practical, or philosophical – that exclude certain plausible ways of perceiving the world? Is it possible that we shy away from unfamiliar scientific perspectives because it is easier to ignore them



than face them? Can it be that certain ideas have been repeated uncritically over such a long period of time that many now believe them to be true – and can this, in turn, have prevented us from thinking certain thoughts or studying certain topics?

When it comes to rethinking educational research in the light of educational neuroscience, I argue that this has a dual advantage: cross-disciplinary issues and

possibilities put educational research in a new light, but education also provides important perspectives on the educational neuroscientific field. My general point is that it does not matter if one approves or disapproves of the linkage of education and neuroscience; what matters is awareness and critical consideration concerning the questions which educational neuroscience poses for educational research.

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