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Innovation development in Norwegian public schools. The relationship between innovation, creativity and imagination

This paper focuses on current research related to innovation development in the Norwegian public school system and investigates the relationship between innovation, creativity and imagination. Using Vygotsky's theory of creativity, the paper describes the concept of innovation and explains how it relates to the Norwegian public school system's creativity education curriculum. The paper explores the importance of hands-on experience and tacit knowledge when developing creativity and innovation. It explores the practice of using assessments in creative subjects and questions whether the current assessment practice allows students to truly develop creativity and innovation skills. This paper argues that although Norwegian public school teachers are knowledgeable about innovation development, true innovation may not be compatible with the current form of assessment practiced in the school system on a national, systemic level.

Keywords: Innovation, creativity, imagination

Innovative Norway

Norway prides itself upon being an innovative and forward-thinking society. As such, the concept of innovation has been given great importance in Norwegian public schools. The terms 'innovation' and 'innovative skills' are mentioned throughout the Norwegian curriculum—not only in traditionally creative subjects such as Art and Crafts but also in traditional STEM subjects (Science, Technology, Engineering and Mathematic) such as Mathematics and Natural science (Kunnskapsdepartementet [Ministry of Education and Research], 2006a, 2006b, 2006c). However, it remains unclear to both teachers and to the public school institution how to actually teach creativity or develop innovative skills in students. How can teachers create an innovative learning process if it is not clear how innovative skills are developed?

To underline the importance of innovation in the Norwegian public school, Torbjørn Røe Isaksen, the current Minister of Education and Research, invited the Norwegian association of local and regional authorities and the other partners to a meeting to about innovation and entrepreneurship in the

school system in 2016. The partners reviewed subjects and competences in preparation for the future national curriculum for primary and secondary education and training (Lindheim, 2016). This can be considered as a clear indication of how important the Norwegian government considers innovation to be for our future generations. Despite the general consensus, both in the government and in the educational system that the development of innovation is important, there are little to no strategies employed to describe how to achieve innovation development.

In order to teach such a complex set of skills, teachers must understand the principles around innovation development as well as its conditioning factors. It is critical to understand that innovation is founded on a basis of creativity and imagination in order to be able to teach it to future generations. It is important to examine where the creativity education is at this current time and how the concepts of innovation and creativity is understood in the Norwegian public school system in the present day. Is there a general understanding of the concepts of innovation and creativity? Since both concepts are complicated to define, it is important to assess the basis for current practices. This paper aims to evaluate the current practices of innovation development in comparison with the premises for innovation development researched in other fields of knowledge.

Innovation in the Norwegian public school system

A review of the general curriculum for the Norwegian public school suggests the concept of innovation appears not only in traditionally creative subjects, but also those based on more scientific principles like mathematics and natural science (Kunnskapsdepartementet [Ministry of Education and Research], 2006a, 2006b, 2006). Terms like 'problem solving' and 'idea development' are used as assessment criteria in most subjects, but there are very few concrete and specific guidelines concerning how to define such skills, let alone develop them. There seems to be a disconnect between what is being taught, as defined by the curriculum, and what is being assessed, as there is no clear definition of what 'problem solving' or 'idea development' really is. How can educators teach and assess something undefined? Teachers are free to improvise but their assessments must strictly adhere to the curriculum. The curriculum's vague definitions of creativity and innovation creates a predicament where teachers are expected to assess a skill according to the curriculum without clear definitions of how to do so. It therefore important that terms like innovation, problem solving and idea development are clarified and standardised to ensure common ground between teachers and students.

The Norwegian Council of Higher Education defines innovation as a modernisation or recreation of an existing element or phenomenon or the invention of a completely novel element (Universitets- og høgskolerådet, 2016). By choosing to use terms like innovation, or terms connected to innovation such as 'problem solving' and 'idea development', the Norwegian government implicitly suggests that the Norwegian public school curriculum is focused on innovation development and creative thinking, and that it plays an integral part in the education and development of youth.

The mathematics curriculum states as follows:

> *The subject of mathematics contributes to developing the mathematical competence needed by society and each individual. To attain this, pupils must be allowed to work both theoretically and practically. The teaching must switch between explorative, playful, creative and problem-solving activities and training in skills (Kunnskapsdepartementet [Ministry of Education and Research], 2006a, p. 1).*

The description does not just mention terms like 'explorative' and 'problem-solving.' It also directly links the development of innovative mathematics skills with the future needs of society at large.

The curriculum for natural sciences, on the other hand, uses the term 'creativity' when describing the core concepts of the subject:

> *Practical and theoretical work in laboratories and in the field using different problems and questions is necessary to gain experience with and develop knowledge of the methods and approaches in natural science. This may contribute to developing creativity, critical abilities, openness and active participation in situations involving natural science knowledge and expertise (Utdanningsdirektoratet, 2006b, p. 1).*

Unlike the description of mathematics, which argues for a creative teaching method in order for students to develop the necessary knowledge, the description for natural science argues that a practical and theoretical approach to the subject may lead to development of a multitude of skills, including creativity. Creativity and innovation may not be at the core of the subject, but the curriculum suggests they play a vital part in achieving a complete and well-rounded understanding of the subject as a whole.

The curriculum for Art and Crafts also highlights the importance of creativity and innovation for society. The general description for Art and Crafts, like the one for mathematics, connects the importance of the development of creativity and innovation to individual growth:

> *The subject [of] arts and crafts has an important position in developing general cultural education. It also prepares pupils for a number of further education[s], trades and occupations. Aesthetic competence is a source of development on several levels, from personal growth, via influence on one's personal surroundings, to creative innovation in a larger social perspective (Kunnskapsdepartementet [Ministry of Education and Research], 2006, p. 1).*

Whereas the natural science curriculum suggests the subject could help develop creativity, the curriculum in Art and Crafts states that the development of aesthetic competence is without a doubt a source of creativity and innovation. The description signals the Norwegian governments belief in the value of the subject Art and Craft as well as the impact it could have on other subjects or on the individual as a whole.

In 2015, the Ministry of Education and Research in Norway presented an official report regarding the Norwegian public school system called *Fremtidens skole–Fornyelse av fag og kompetanser* [*The School of the Future—Renewal of subjects and competences]*. This report aimed to investigate the current school system and describe how the future system should be organised. From the outset, the report links creative subjects with innovation in connection with one of the four suggested learning aims one of which is named as follows; competence in research and creation (NOU 2015:8, 2015). This signals a change in the Norwegian public school system in which the importance of creative subjects is connected to innovation and a forward-thinking educational system.

The report *Creativity, innovation and entrepreneurship* (Abrahamsen, Berg, Henriksen & Sjøvoll, 2011) evaluates Nordic countries' school system's integration of creativity, innovation and entrepreneurship from kindergarten to university. The report describes creativity, innovation and entrepreneurship as different sides of the same, multifaceted coin. It could therefore be argued that each side of the coin is equally important and further argue that you cannot have one component without the other. For example, you cannot have innovation without creativity.

Innovation and creativity

Creativity should not be overlooked when considering the development of innovation. Although the relationship between creativity and innovation is strong, these two concepts are not equal, neither in definition nor in reputation, and have notable differences. Eva Lutnæs defines in her article *Imagining the Unknown - Responsible Creativity for a better tomorrow* in *FORMakademisk* creativity as "the ability to create valuable and meaningful new ideas based on knowledge of previous work" (2015, p. 9). This definition agrees with Vygotsky's conception of creativity as the ability to assemble experienced elements in new ways into a new product, whether physical or conceptual (Vygotsky, 2004 [1926]).

There is a clear connection in Vygotsky's research between creativity and imagination, suggesting the importance of understanding the place of imagination within creativity and innovation. The components of creativity is based in the imagination, something Vygotsky charts in his article *Imagination and Creativity in Childhood* (2004 [1926]). Vygotsky argues that children develop imagination and creativity in the context of their cognitive development and day-to-day experiences. According to Vygotsky, imagination is an essential part of being human that first develops in early childhood and he argues that imagination and creativity develop as a child's increased sensory awareness expands. Early in a child's development, imagination fills a gap between what the child has experienced and what he or she understands. The more the child has experienced, the less it needs to resort to imagination in order to understand or justify the world around it.

At the same time, imagination is a product of a child's experiences (Vygtosky, 2004 [1926]). The building blocks of imagination are created through experience, meaning that the older a child becomes and the more he or she experiences, the more potential imagination they have. This may seem like a paradox given that adults, who would seem to have the greatest potential for imagination based on their experiences, do not use imagination to the same extent as a child (Vygotsky, 2004 [1926]). There are many indications that adults generally do not need to fill the space between their experiences and reality since they have experienced larger parts of the world and acquired a greater understanding of it (Vygotsky, 2004 [1926]). Lev Vygotsky describes it as follows in his article *Imagination and Creativity in Childhood*:

> *[The] creative activity of the imagination depends directly on the richness and variety of a person's previous experience because this experience provides the material from which the products of fantasy are constructed. The richer a person's experience, the richer is the material his imagination has access to. This is why a child has a less rich imagination than an adult, because his experience has not been as rich (Vygotsky, 2004, s. 15).*

Vygotsky describes imagination as a product of humankind's future-oriented evolution (Vygotsky, 2004 [1926]). Imagination plays a large role in creative activity that combines familiar elements with the unknown in what Vygotsky calls combinatorial creative activity. Combinatorial creativity is the ability to combine two seemingly separate experiences into a new one, which is largely exercised by children in order to understand the world around them, as mentioned above. This kind of creativity shows how imagination is deeply rooted in the real world, as each individual component is an experience based in reality, and what could exist in the future by combining separate sensory experiences in new innovative ways.

An imagination based on a multitude of diverse experiences is a prerequisite for combinatorial creativity (Vygotsky, 2004 [1926]). All innovative, creative acts require the actor to have experience with the media with which they work, whether in art, science or design. If you see imagination and combined creativity in the light of an action that creates something tangible, it is essential that the creators making new tangible objects must have a real understanding of its constituent elements and its potential for development in a given field in order to achieve a functional product (Sennett, 2008).

If making the assumption that an idea springs from imagination (and therefore a combination of experienced elements), the true success of an innovation lies in the implementation of the actual design of a product. That success rests on whether the creator has a relationship with the product and a hands-on knowledge of desirable improvements or changes (Sennett, 2008). One can say that innovation is about making imagination real. If innovation is a product of creativity that requires an element of imagination, innovation in many ways is an act of imagination. The question then becomes; how to facilitate the in-depth knowledge necessary to create a successful innovative product?

Circular metamorphosis

Past research has shown the concept of repetition to be a vital part of the creative process. As previously discussed, Vygotsky (2004 [1926]) argues that imagination is determined by the richness of an individual's experience. Knowledge and understanding of the surrounding world is created through immersion in the physical or metaphysical world, broadening the horizons of an individual. In many ways, this resonates with the arguments made by Richard Sennett in his 2008 book *The Craftsman*. An advocate of hands-on experience and tacit knowledge, Sennett highlights the importance of life experience as well as the repetition of tacit knowledge (Polanyi, 1958). The author argues that repetition creates an intimate knowledge of a given subject that allows individuals to go beyond their past learning.

Sennett describes a creativity paradox within architecture in which computer-generated drawings have taken over hand drawings in the design process. With the help of so-called computer-aided design (CAD), architects can create visual tools quickly and efficiently and can immediately change the same drawings without having to rewrite their work. CAD drawing software gives an architect not only a plan or section drawing, but also a three-dimensional model where lighting conditions can be added by means of a keystroke.

Although CAD tools seem to be the best friend of the architect, Sennett argues this is not the case. He argues that by relating only to a computer-driven model, the architect loses a certain part of his or her understanding of the building, the space and the project itself. It is through repetition of drawings, small changes and reconfigurations that need to be rewritten that the architect has a solid experience with the project and how it will be built. The process of going from original sketch to architectural drawing to visit the building site and then back to the drawing board to change the drawings creates an intimacy between an architect and a project. Sennett calls this type of repetition and exercise a 'circular metamorphosis', where the architect can create one or more changes in a project based on inherited conditions in the building.

Another side effect of the repetition and exercise of circular metamorphosis is that the architect or craftsman is constantly developing his or her concrete dexterity with architectural drawings. Sennett describes in his book The Craftsman a conversation where a student at the Massachusetts Institute of Technology related her experience with circular metamorphosis:

> *When you draw a site, when you put in the counter lines and the trees, it becomes ingrained in your mind. You come to know the site in a way that is not possible with the computer. . . You get to know a terrain by tracing and retracing it, not by letting the computer 'regenerate' it for you (Sennett, 2008, p.40).*

The quotation highlights Sennett's argument about skilled experience as a kind of knowledge. Experience creates an invaluable bond created between craftsmen and his or her aesthetic process because the craftsman continuously has to circle back to the starting point to make changes. Repetition creates a deep anchoring of the task or the work of the practitioner. It also creates a different and more complete understanding of the work itself. The practitioner will, after a finite number of repetitions, know the site like the back of their hand and will therefore be much better equipped to make informed decisions and alterations to the drawing.

Innovation and creativity in the Norwegian public school system

In *Imagining the unknown: Responsible Creativity for a better tomorrow*, Lutnæs (2015) describes an interview with an Art and crafts instructor in which where a teacher questions the need for originality in the field. The comment pinpoints the difficulty of having an assessment of student work in a class in which students largely work from a template designed by the teacher. "The students had redesigned the teacher's model and her doubts about expectations of originality were most reasonable", Lutnæs writes (p. 7).

From an innovation and creativity standpoint, however, it can be argued that copying is only a form of search for material knowledge and experience, even if it is problematic for assessments. This need to copy and reproduce existing work is in many ways similar to Sennetts argument for tracing and retracing an architectural site. The practitioner acquires knowledge by copying their own, or others, work. The Norwegian school system may place too much value on the requirement for originality. Lutnæs argues that this is partially due to the Norwegian public school practicing a product-oriented assessment form. This type of assessment is largely, if not only, based on the final product of any educational situation, as in a finished painting or end of year final exam (Lutnæs, 2015).

The Swedish public school, however, mainly focuses on a process-oriented assement form, where the documentation of the learning process is vital to the assessment. Lindström's (2006) study of Swedish school with pupils aged 5 to 19 showed how the school emphasizes portfolio assessments focused on individual students' progress as well as their self-reflection around their work. The school system surveyed by Lindström is comparable to the Norwegian school system culturally and systemically. Based on Lindström's survey, the Swedish educational system is more process-oriented than product-oriented, which could be a possible solution for the Norwegian school system. At the same time, Lindström points out that although the students were reflecting on their own creation process and abilities, there was a clear difference between the students' knowledge and skills and their understanding and recognition of their own creative process (Lindström, 2006).

If this finding is linked to the theory of experience-based creativity (Sennett 2008; Vygotsky, 2004 [1926]), the Swedish students show a greater degree of experience and conscious decisions in relation to their creation processes. Lutnæs (2015) problematizes the Norwegian school system's focus on product orientation rather than a process orientation. The author questions why Norwegian schools do not aim for a process-oriented learning arena where the goal is learning itself rather than the product of the class.

Creativity as knowledge

Larsen 's master thesis *Kan kreativitet læres eller er det knyttet til individets anlegg? [Can creativity be learned or is it related to the individual's facilities*] (2007) at the Faculty of Educational Sciences at the University of Oslo, explains the psychological development of creativity, the extent to which it can be learned, and whether it an innate individual trait. Larsen concludes that creativity is a form of knowledge that can be learned and taught. She also describes the concept of flow theory, as described by psychologist Mihaly Csikszentmihalyi. As illustrated in Figure 1, flow theory is a description of the individual's development potential within a given area. Larsen describes this as "the optimal interface between the individual's competence and the requirements of the task" (Larsen, 2007, p. 30, my translation from Norwegian).

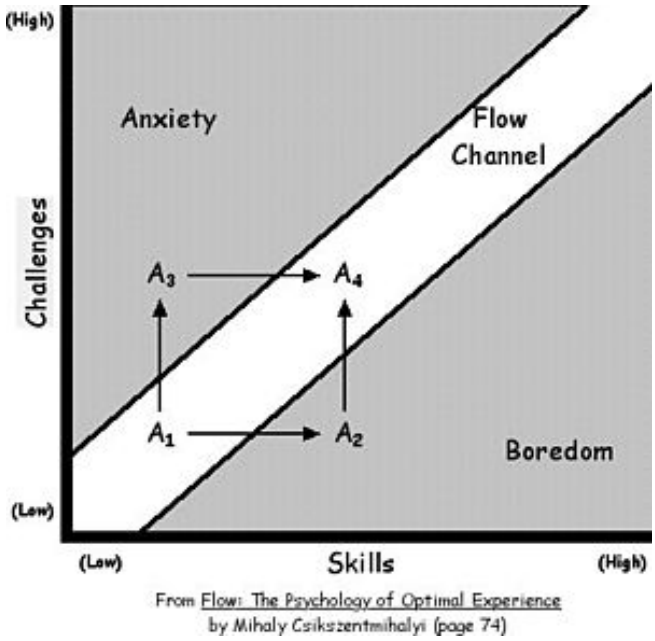

Figure 1. Flow theory model.: The Psychology of Optimal Experience (https://en.wikiversity.org/wiki/Motivation_and_emotion/Book/2011/Flow)

Looking at this model in relation to the development of creativity and its connection with experience illustrates the importance of experiencing creativity as a kind of skill. When creating a learning experience the object of should be to work at level A1 aiming for level A4. The mark A2 is covered by what the individual already know and provides no further learning opportunities, the mark A3 is beyond what the individual is able to grasp. The individual should therefore, based on the known experiences in level A2, aim towards A3 through the more achievable level of A4. The existing experiences at level A2 serves as building block to achieve the levels above. Seen in connection with an experience-based learning form, experience arguably must serve as a basis for possible learning in all subjects. These points are supported by Sennett's thoughts on repetition and hands-on-experience (2008) as well as Vygotsky's theory of imagination (2004).

However, one can question whether this process is the reality of Norwegian creativity education, especially when considering Lutnæs' findings (2011). In Norway, creativity and originality are considered a requirement for assessment. But looking at creativity through flow theory, such a mindset undermines the entire creative and innovative process. If school administrators want to introduce innovation to their students' learning perspective, hands-on experience with the materials will be invaluable and should be continually developed.

Is it reasonable to expect a student to develop a solid expertise within a particular topic, as argued by Sennett, and then to create something innovative and creative, through Vygotskys theory regarding combinatorial creativity, given the limited time frames with which the Norwegian school system operates today? Vygotsky and Sennett argue for the continuous development of innovative capabilities, whether in cultivating imagination or creating crafts. A condition to both Vygotsky's and Sennets' theories is the concept of *time*, and the *time and space* do develop a skill or acquire new experiences. Process learning can become a key tool that opens for a lasting connection between experience and innovation. Set against Lutnæs' description of a product-oriented school system in Norway, one can argue that the development of innovation in the Norwegian school system today is at best challenging.

Convergent and divergent creativity

In *Convergent Creativity: From Arthur Cropley (1935-) Onwards*, Ai-Girl Tan (2015) outlines developments in creativity research over the past few decades. The article addresses the view of convergent and divergent creativity and the legacy of J. P. Guilford as well as that of Arthur Cropley, who challenged Guilford's theories surrounding creativity. According to Guilford, convergent creativity is a process based on a predetermined outcome at the start of the task. A divergent creative approach is dependent on absolute freedom after the task has been set (Guilford, 1964). This difference can be described as an opposition between *radical and disassociate* creativity on one side and *responsive and combinatorial* creativity on another.

When considering the two types of creativity, divergent creativity is often considered the optimal form because, its proponents argue, its radical and free form enables a true originality (Cropley, 2006; Tan, 2015). Cropley's (2006) argues that convergent creativity is preferable in an educational setting, as this type of creativity teaches a sense of purpose in its process. Convergent creativity is dependent on an aim and requires achieving a goal, whereas divergent creativity appears to be a source of unruly chaos in comparison (Tan, 2015). However, the two types of creativity work best if combined. In Cropley's article *In Praise of Convergent Thinking* (2006) it is argued that although divergent thinking previously had been thought of as the only creative way of thinking, convergent and divergent thinking are more interlinked than what was once assumed. Cropley believes that convergent thinking is better suited for educational purposes as it offers a wider range of teachable skills and is a goal-oriented process that builds on previously attained skills. Although both divergence and convergence are a part of a creative process, a process based only on divergence will create a haphazard result, while one oriented around convergence will arrive at a predetermined goal.

The preference for divergent thinking may lie in the assumption that convergent creativity is bound and constrained in its thinking. As Joy (2015) points out, there seems to be an inclination toward the divergent method amongst those who evaluate creative products, but is this the best approach for educators? The absence of structure in divergent tasks could create not only a complex learning environment, but also an inconsistent assessment.

The originality paradox

As outlined in Eva Lutnæs' (2015) article *Imagining the unknown. Responsible Creativity for a Better Tomorrow*, Art and crafts educators in Norwegian public schools struggle with the concept of originality in an educational setting as originality is hard to teach and hard to assess, yet often expected in the product-oriented assessment form. The expectations of originality in student work is sometimes counter-intuitive, much due to the fact that the students develop their skills through repetition and imitation of example work, particularly the examples and techniques provided by the teacher. In light of Sennett's (2008) arguments around tacit knowledge and circular metamorphosis, it seems in many ways unfair to judge a student's ability to produce a novel element when they do not have the necessary experience with component materials.

One part of the problem may lie in the general public's conception of novelty and originality as deeply linked with what they see as true creativity. The public seems to prefer the divergent creative method (Cropley, 2006). However, the divergent approach often leads to a haphazard result (Cropley 2006). Although divergence is an established creative method, the result is often a product of complete accident. The final result cannot be predicted and the process is as much in danger of failing as it is likely to succeed. In an educational setting, the concept of assessing a learning situation where the final product could be coincidental seems farfetched, and the prospect of teaching such creativity even more so. It is therefore surprising that the divergent creativity seems to be preferred in an educational setting. Stephen P. Joy (2012) describes in his research article *Origins of Originality: Innovation Motivation and Intelligence in Poetry and Comics* a study in which students were given

the task of writing and illustrating poems before arguing for a new understanding of divergent thinking. In said study Joy makes the following argument:

> *Divergent thinking is associated with superior creative products, and judges respond to divergent thinking in their evaluation of creativity (Joy, 2012, p. 211-212).*

This preference seems to also be present in the Norwegian school system (Lutnæs, 2015), even though it is not necessarily the best approach to creativity teaching. Joy further argues that although divergence might be a vital component of the creativity process, it is not necessarily sufficient as the sole creative approach. That being said, convergent creativity may not be sufficient on its own to inspire innovation.

In the Norwegian public school system, there seems to be a favouritism towards goal-oriented learning, which in many ways lends itself to the divergent creative method (Lutnæs, 2015). This is particularly true as the concept of originality is valued as the epitome of a creative task. Compared to the process-oriented assessment practiced in the Swedish public school system, the Norwegian system is based on the final product (Lindström, 2008). One could argue that due to the fact that the assessment in the Norwegian public schools depends mainly on the quality of the final product, the level of originality becomes increasingly important. However, if Norwegian schools adopt a more process-oriented type of assessment and a convergent method to creativity, assessments and teaching methods would need to change.

Sennett (2008) describes the concept of master-novice learning as a process where the master teaches the novice through hands-on experience. The knowledge acquired through observation and replication is essential and deepens the student's understanding of the material. In master-novice training as Sennett describes it, there is no concept of originality, but rather the value of deep understanding. Seen in relation to the Norwegian public school system, this would translate to a teacher-student relationship. The teacher should be seen as a master teaching its novices through demonstration and observation. The concept of originality is not essential in this process as the object of the process is learning through trial and error. The master creates a structure within which the student is allowed to explore, guided by the teacher. The crossover between this relationship and the concept of convergent creativity is apparent.

Relating this understanding back to the research of Lutnæs (2015) reveals that the concept of originality should not lie outside the constraints of the assigned task, but rather on how the student approaches the tasks within the frame itself. Perhaps the originality lies within the frames, not beyond them. The tacit knowledge the student has acquired should allow him or her to experiment within the structure of the task (Sennett, 2008). The ability to work within the compounds of a task and its manipulations of its elements would demonstrate a student's knowledge of it. The process is arguably much more worthwhile than a finished product created by chance, regardless of how original it is (Lutnæs, 2015; Lindström, 2006).

This does not mean that the value of divergent thinking should be completely disregarded. The ability to make explorative decisions and choices beyond the task should be encouraged to a certain extent (Joy, 2012). Perhaps divergent tasks become convergent once a student has reached a high level of tacit knowledge, allowing him or her to make informed decisions. The ideal instruction style would teach creativity with a purpose and but give students the ability to move beyond structures provided by their teachers.

Innovating innovation

The Norwegian government and society at large place a great deal of importance on the idea of innovation, especially in the school system. Creativity and innovation are in some form or another specified in most curriculums, regardless of the subject. Whether the topics are variously considered to be a by-product of the teaching method, a possible arena for development, or a certain source of personal growth. Lately there has been a shift in focus where creative subjects such as Art and Crafts

have been seen as a valuable arena for development and innovation. However, there is a disconnect between what is written in the curriculum and what is practiced in schools.

There seems to be a divide between the intention of the curriculum and what is actually being taught, much of it due to the vagueness surrounding the terms innovation and creativity. There needs to be a standardisation of the terms and development of a more hands-on approach on how to develop creative and innovative skills. There also needs to be further research into the individual components of creative skills so that educators are able to understand develop each skill individually.

The inconsistency of current innovation education seems to be the Achilles' heel in the Norwegian public school system, whether in relation the form of assessment practiced, the preferred type of creativity or the time and resources dedicated to teaching innovation as a whole. If teachers across all subjects do not know how or what they are teaching or do not have the resources available to them, we cannot expect the development outlined in the current curriculum to be realised. Perhaps, then, the current innovation practice needs to be innovated.

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