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Intelligence defined as the ability to learn, discussed in a dynamic perspective. Comments on the interpretation of IQ testing and suggestions for some educational implications

There is currently no unified understanding of intelligence. Over the years, there has been a discussion about the impact of heritage and environment and whether intelligence and intelligent functioning can be understood as a predominantly hereditary phenomenon or primarily social construction. This article discusses a line over several researchers spanning from the early part of the previous century to the present time, who perceive intelligence as dynamic, malleable, and changeable. The Flynn effect – the fact that IQ has been shown to increase across generations – is also part of the picture. With this, among other things, as a backdrop, this article problematizes whether a general, full-scale IQ score is a reliable measure for the development of good predictions of future school performance. Further, it is pointed out how a dynamic perception of intelligence can affect the interpretation of low/lower IQ findings in studies, so that measures can be put in place to prevent (too) negative predictions from living their own lives – in cases where these are not really valid. The article closes with the discussion of a well-proven educational-psychological approach. In the author's view, employees in Educational-Psychological Services and the like ought to have good knowledge of this approach. In the concluding part, some case studies utilizing Systematic Concept Teaching undertaken over 3–5 years are discussed, in which marked increases in IQ scores are registered.

INTRODUCTION

Some professionals in education and psychology − not to mention people in general/ laypeople – still seem uncertain as to whether intelligence and the ability to learn is a more inherited property or whether it is more a property that is largely changeable, modifiable, and flexible, given the circumstances one is born into and the conditions under which one grows. This uncertainty is not unusual since there are many thoughts and theories concerning what intelligence is (e.g. Cianciolo & Sternberg, 2004; Sternberg, Lautrey & Lubart, 2003; Kaufman, 2009; Plucker & Esping, 2014; Sundet, 2015).

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In this article, the main focus is on intelligence understood as a dynamic property – as opposed to an understanding of intelligence as a more static and unchanging matter.

Furthermore, attention is given to how a dynamic understanding of intelligence can affect the interpretation of future possibilities for children/students who achieve low/lower IQ scores in assessment contexts. This interpretation can impact the recommendations given on such a basis for these children/students.

Finally, a possible proposal for educational-psychological implications for low/lower IQ scores in children/students with language and learning difficulties is discussed. Moreover, it is pointed out how professionals can undertake teaching in principal to prevent language, learning, and related problems in school subjects as much as possible.

TWO MONUMENTAL CONTRIBUTIONS

According to Haywood (2016), Frenchman Alfred Binet and his colleague Theodore Simon made two monumental contributions to psychology in the early 20th century. One of these became very well known, while the other was little-noticed and long remained cloaked in obscurity. The contribution that became known was their first "ability test" in French (basic version in 1905 followed by revised and expanded versions in 1908 and 1911), which received its well-known sequel through the Stanford-Binet Intelligence Scales (Terman, 1916), which was published in the USA. This test is often perceived as a precursor to most modern intelligence tests. For some decades, the contribution that remained more or less unknown was their plan for "Mental Orthopedics," a program for developing cognitive skills in children/students who needed cognitive stimulation.

A COGNITIVE TEST AND MENTAL ORTHOPEDICS

According to Binet (cited from Gould 1996, pp. 176–184; and from Parmenter 2001, pp. 272–273), the overall objective of the test was to find a scale or test that could identify the children/students who due to lack of success in the regular class needed "special education" in one form or another.

In line with this purpose, Binet had straightforward suggestions on how these children/students should be taught. As already pointed out, in his opinion, they needed "Mental Orthopedics" before being taught the basic school subjects. These included exercises/tasks to develop motivation, attention, and cognitive discipline, etc. Said in another way: They had to learn how to learn. Binet believed that learning ability could not only be considered an unchangeable and inborn capacity, but something that could also be developed through good teaching/training, at least up to a certain level. In testing his program to teach developmentally disabled children/students to learn, Binet found that a year of participation in his plan of Mental Orthopedics resulted in academic progress corresponding to two years in school for the participants (Cianciolo and Sternberg, 2004, p. 59).

In what follows, lines are drawn to some later developed "constructions" or ways of thinking representing much of the same understanding. As will be seen, the understanding of intelligence as a flexible and modifiable property represents the main theme of this article.

LATER "CONSTRUCTIONS" THAT INDICATE FLEXIBLE LEARNING OPPORTUNITIES

Gradually it turned out that professionals did not forget Binet's ideas about "Mental Orthopedics" (Haywood, 2016), but that these gained new life later in the 20th century through new constructions, such as "*the zone of proximal development"* (Lev Vygotsky), and *"mediated learning experience"* (Reuven Feuerstein). In addition, I would add Magne Nyborg as a Norwegian representative who early on developed a similar understanding of

learning and the development of abilities and intelligence, as expressed through his eclectic theory of learning and his formulations on teaching and the positive change of *language-related prerequisites for learning.*

VYGOTSKY'S ZONE OF PROXIMAL DEVELOPMENT

As many are aware, Vygotsky (1894–1934) (1978) maintained that what the child is able to perform on her/his own, without any help, represents what he describes as "the zone of actual development (ZAD)," while the zone of what the child is able to do with the assistance of a more experienced partner (a classmate, a teacher or a parent), is referred to as the "zone of proximal (next) development (ZPD). Below are some comments on the mentioned concepts in connection with Figure 1.

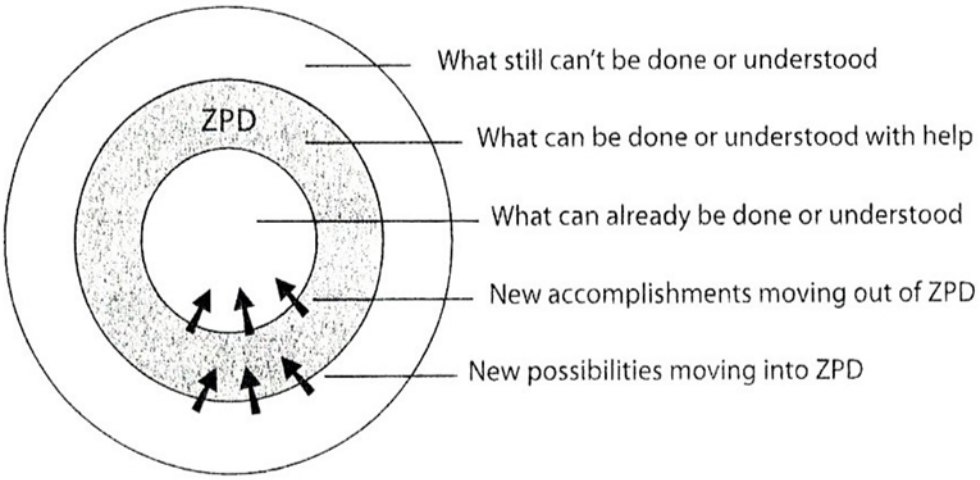

Figure 1: The next or nearest development zone seen in relation to other zones
Frank Smith (1998, p. 84)

The inner circle of fig. 1 represents everything that the child/student already knows and can do independently. Thus, this circle represents the sum of the child's/student's knowledge and skills as they are experienced and acquired during the student's life up to the assessment time (the actual development zone). Outside this inner circle comes a larger circle (with a darker color). This circle stands for everything that the child/student does not yet know or cannot perform on their own but can understand and perform with the help of more capable others (the zone of proximal development). Thus, this zone stands for the "area" where the child/student is helpless on his/her own, but can be competent with assistance. Outside this zone, you will find the area where the child/student cannot understand or complete something, no matter how much help she/he is given.

According to Vygotsky, the boundaries between the areas/circle fields are always changing. Frank Smith (1998, p. 85) is commenting this idea as follows:

> *The mass of things we know and can do in the inner circle expands as we gain in experience. Things in the zone of proximal development that we can accomplish if someone assists us, move into the inner circle of things we can accomplish by ourselves, and some things which have been in the region of matters totally beyond our competence, with or without assistance, move into the zone of proximal development, where we can accomplish and understand them with assistance. Provided there is someone at hand to help us when we seek assistance with something*

in our zone of proximal development; we will constantly and effortlessly increase the number of things we are capable of doing for ourselves right now and also increase the number of things we are potentially capable of doing in the future.

Smith further comments that Vygotsky did not explicitly mention that one of the things that is constantly in the immediate development zone is our self-image (read the child's/student's self-image). This includes our belief in what we will be able to or will not be able to perform in the future. Smith (1998, p. 85) also points out some probable consequences:

If someone persuades us that we are unlikely to learn something that we are 'not the kind of person' who can learn these kinds of things, entire areas of learning can remain in the outer reaches of the zone of things that we will never be able to accomplish, with or without assistance. We learn to erect solid and immovable walls where flexible boundaries should exist.

The quote discusses mechanisms that are recognized in the well-known topic of expectation effects and self-fulfilling prophecies, often referred to as the Pygmalion or Rosenthal effect (Rosenthal & Jacobsen, 1968; Friedrich et al., 2015; Rubie-Davies et al., 2015; Sorhagen, 2013).

NYBORG'S DEFINITION OF ABILITY TO LEARN AND CHANGE OF LANGUAGE RELATED PREREQUISITES FOR LEARNING

Under this heading, in light of this article's title, I here convey Magne Nyborg's (1927–1996) understanding of the problems that constitute the main idea in this article. He defines intelligence as the ability to learn in a transferable way. In this sense, ability is understood:

as a designation for a very highly learned, current capacity; capacity to perceive, learn, remember, think, solve problems, act, etc., without deciding to what extent this capacity is rooted in and also reflects original facilities or potential. (Nyborg, 1980, p. 259). (Translated from Norwegian)

The fact that ability in this sense can and must be learned, through both upbringing and teaching, is central to Nyborg's learning theory (Nyborg, 1985, 1993; Hansen, 2006). This implies a continuous change of prerequisites for learning in the person as new experiences arise. The latter is a view that is clearly supported by relatively recent research on (brain) neuroplasticity – which in simple terms has to do with how our brain is under constant reorganization based on the experiences we have, as this is discussed e.g. by Doidge (2007); Norberg (2013) and Dietrichs (2015).

As can be seen, intelligence or the ability to learn is related to learning in a transferable way. In other words, learning in light of what is learned and stored in memory so that this is transferred to new learning. At the same time, one should be aware of the fact that transfer can also have a negative character so that later learning is inhibited or directly prevented. Transfer of learning is otherwise a very controversial and multifaceted concept, as this appears from, among others, Detterman and Sternberg (1993), McKeough, Lupart and Marini (1995), Schunk (2000), and Kaniel (2001) and will therefore not be the subject of discussion here.

In the early 1970s, Nyborg developed an understanding of intelligence and ability as dynamically malleable, modifiable, or teachable. This view had its background in his work

before as well as in his doctoral dissertation from 1971, in theoretical studies, and in his implementation of a comprehensive 3-year special education field experiment (Lyngstad and Nyborg, 1977). As Nyborg perceived it, this was in contrast to the often more static perception among relatively many educators, psychologists, and researchers in their understanding of intelligence and intelligent functioning as predominantly defined by innate prerequisites.

In light of Binet, it is interesting to note that Nyborg (1980), about 70–75 years later, argues that results on traditional ability tests, administered as prescribed, should also be interpreted far more dynamically than what in his opinion had been common to do in connection with educational-psychological assessment and recommendations. This may open up opportunities for the application of educational measures for children/students to improve their ability to learn. This approach requires that the test interpreter is not "blinded" by their belief in static abilities, i.e., that the tests measure something that is static or immutable in the child or student. Nyborg further argues that if the educational-psychological assessor has performed a sound intelligence test, with findings of a lower intelligence score (from 90 points and down), and this result corresponds to the child's/student's functional level in many other contexts, this should be a signal that the following education recommendation should be presented:

> *The child/student must receive systematic language training with regard to a variety of instrumental language features, where conceptual functions – as a component of meaning or understanding in language – are very strongly emphasized. (1980, p. 261) (Translated from Norwegian)*

It is essential to be aware of the fact that Nyborg does not argue against other types of teaching as components of an adapted educational intervention. Still, at the same time, he clearly states that the recommended intervention in required cases must be undertaken in a responsible manner. The recommended intervention will be discussed more towards the end of this article.

FEUERSTEIN AND MEDIATED LEARNING EXPERIENCE

Another internationally renowned psychologist and researcher who early on developed a dynamic understanding of intelligence was the Israeli psychologist Reuven Feuerstein (1921–2014). He is particularly known for his pioneering work on cognitive modifiability, formulated in his theory of structural cognitive modifiability – Feuerstein, 1979, 1980, 1988. He is also known for his instrument for the dynamic assessment of learning potentials (the Learning Propensity Assessment Device), which is often abbreviated as the LPAD model. A key concept in Feuerstein's theory is what he describes as mediated learning experiences.

In connection with the theory of structural cognitive modifiability, Feuerstein understands intelligence as an individual's "propensity" (defined as potential in the form of an inherent prerequisite, power, energy) to adapt to new situations through modifications of the individual's cognitive system. The theory postulates that humans can change structurally in their cognitive, emotional, and behavioral functions. Put another way: the individual is largely perceived as an open system where the functionality depends on the special experiences that the individual makes during his/her development.

Based on his theory and assessment system, Feuerstein has developed an educational intervention program called the Instrumental Enrichment Program, of which there is a version for older children/students and adults: FIE (from 9 years and up) (1980) and a version for younger children: FIE-Basic (4–7/8 yrs.) (2000). The FIE-Basic was developed in a collaboration with Rafi S Feuerstein.

THE BELL CURVE (THE NORMAL OR GAUSSIAN DISTRIBUTION) AND "COUNTER BOOKS"

Despite the development of a more dynamic concept of ability than before, as exemplified by Nyborg and Feuerstein, the static view of intelligence and ability persisted. This view was, among other things, expressed in the book *The Bell Curve. Intelligence and Class Structure in American Life* (Herrnstein & Murray, 1994). Based on a presentation and an extensive discussion of empirical material on the subject, the Bell Curve ended up with a view of intelligence as largely genetically determined and highly hereditary. A statistical correlation was found between crime, poverty, and low intelligence. Not least, it was claimed that there is a connection between the black population's average lower intelligence, as the book argued, and crime and poverty.

The book sparked a significant debate about the concept of intelligence both academically and publicly through the mass media. Several "counter-books" were published with researchers' contributions from various disciplines (e.g., psychology, pedagogy, biology, law, sociology, etc.). An example of a serious counter book with "heavyweights" from various disciplines was: *Intelligence, Genes and Success. Scientists Respond to the Bell Curve* (Devlin et al. 1997).

In Europe, there was also a significant discussion about the Bell Curve and intelligence. The book *Is Intelligence Modifiable?* (Martinez et al. 1997) was a product of such a discussion and a direct consequence of a conference in Madrid in December 1995. The central theme was whether intelligence could be considered modifiable, in the sense that it is possible to influence intelligence through the adaptation of environmental conditions in the broadest sense, including educational-psychological measures. At this conference, professionals from both Europe and the United States discussed the topic extensively. The answer to the conference's central theme/question was a clear yes in the sense that intelligence was understood as modifiable, even though intelligence was also perceived here in a slightly different way.

The concept of intelligence was in itself the subject of discussion because it does not seem to have any functional value as a basis for thinking about the content of modifying measures. Alternative concepts such as abilities, learning potential, and prerequisites for learning were discussed as substitute concepts or alternatives without the discussion culminating in anything more tangible. These extensive reactions seem to indicate that the view of intelligence and learning ability among many professionals had moved towards a more dynamic view than before.

VARIABLE IQ AND "DEVELOPED" ABILITIES

A similar view clearly expressed in Anastasia and Urbina's authoritative book on *Psychological Testing* (1994, p. 298) claims that

> *..., One empirical fact is well established: the IQ in not fixed and unchanging; and it is amendable to modification by environmental interventions.*

Anastasia and Urbina choose to use the term *developed abilities* as a general term which implies that the qualities measured via tests for general intelligence, via tests of "facilities" more generally and specifically (aptitude tests), and via tests in various disciplines (tests of achievement), can be developed, modified or learned. As can be seen, Anastasia and Urbina obviously also represent a dynamic view of abilities and intelligence.

CAROL DWECK AND "FIXED MINDSET" AND "GROWTH MINDSET"

A more recent concept that corresponds a lot with what is referred to above as a dynamic view of intelligence and abilities is Carol Dweck's (2012, 2015) "Mindset" concept. She distinguishes between a "growth mindset" and what she describes as a "fixed mindset". The growth mindset is characterized by the belief that properties can change and that we can develop our intelligence and abilities. Of course, the opposite is a belief that intelligence and abilities cannot be changed or developed but denotes something that is mainly hereditary. The definition of the growth mindset is important to keep in mind because the research of Dweck and colleagues has shown that this specific belief makes people dare to take on challenges, become more motivated, work harder, and persevere more when they encounter difficulties/ obstacles. All together this belief results in better and increased learning.

The alternative perspective, the fixed mindset, often results in adversity becoming an obstacle to further wholehearted involvement and work on the relevant learning task. Instead, shortcomings are interpreted as a result of not being smart enough. It is also difficult to change such behavior without at the same time working to change people's perception of the concept of ability.

Dweck (2015) warns against misunderstandings and pitfalls that one can fall into regarding the growth mindset. The most common, she claims, is perhaps that one equates the mindset with making an effort. Of course, effort is important to be able to perform, but this in itself is not enough. Children/students also need to try out new strategies and input from others when they are stuck. They need a repertoire of approaches to learn and develop.

Dweck also points out that praise is too often given for children/students to feel good, even when they have made an effort without succeeding in a task. She does not think this is appropriate in itself. When they are "stuck", the teacher can express that s/he values the effort so far, but at the same time add: "Let's talk about what you've tried, and what you can try next" (Dweck, 2015, p. 2).

Dweck also points out that if one wants to hide learning differences among children/students, one can only express that everyone is smart, but the growth mindset intends to help even out learning differences, not hide them. It is about telling the student what s/he is achieving now and together doing something about it, contributing to him/her learning and becoming smarter. Dweck also states that the concept of mindset can sometimes be used to explain why some children/students do not learn much by assigning children/students a fixed mindset, while one should instead concentrate on facilitating the best possible learning in children/students.

She also refers to research showing that so-called "false" growth mindsets in teachers and parents have been observed. These are people who claim to have a growth mindset, since this is perceived as the correct mindset, but who do not live up to this in words and deeds. This way of behaving has been shown to have an adverse effect on children/students' learning. Dweck states that the path to a growth mindset is not something one proclaims to but is more the result of a journey. It takes time, and the landscape changes over time.

Dweck (2015, p. 3) also asks the question: "How can we help educators adopt a deeper, true growth mindset, one that will show in their classroom practices?" She responds in a way that, for many, can be perceived as paradoxical that the fixed mindset should be legitimized. We should acknowledge/ admit that:

1. We all have a mix of growth and fixated mindsets.
2. Something we probably always have.
3. Whether we want to develop more of that growth mindset in our thoughts and actions in the field of practice, we must be in touch also with our fixed mindset and actions.

Her view is further that if we deny (ban) the fixed mindset, we will undoubtedly create false growth mindsets. Dweck encourages teachers to consider whether they use a fixed mindset when faced with challenges? Do you feel too (overly) anxious, or do you hear an inner voice say that you have to "shadow" away, she asks? Look for similar signs when you encounter adversity in your teaching or when children/students do not follow or learn, she continues. Dweck further encourages you to consider whether, in such cases, you feel incompetent or knocked out? Or could it be that you are trying to find an excuse? Whether criticism activates one's fixed mindset is also essential to consider. Do you become defensive, angry, or crushed instead of learning from the feedback? Follow what happens when you experience an educator who is better than you in something you value highly. Do you feel jealous and threatened, or do you become eager to learn more? Dweck attempts to contribute to a realization of which mindset one operates with. She emphasizes that one must accept such thoughts and feelings and work with and "through" them, a work that must go its own way (Dweck, 2015, p. 3).

FLUID INTELLIGENCE AND CRYSTALLIZED INTELLIGENCE

Since this article deals with constructions or concepts such as intelligence and learning ability, it may be appropriate to visit a dichotomy that has long been considered valid in ways to characterize intelligence. It is about the division into and the difference between the term fluid ability or intelligence and the term crystallized ability or intelligence. Fluid ability or intelligence, i.e., is a side of intelligence which, according to Horn and Cattell (1966), should be relatively independent of acquired knowledge and skills, a term for a person's ability to solve new problems. Crystallized intelligence (crystallized ability or intelligence), i.e., is a side of intelligence perceived as learning-based or dependent on academic and cultural experiences. Put another way: crystallized intelligence reflects the knowledge a person has acquired from school and culture in general.

There is good reason to question whether this dichotomy with its explanatory background can still be considered valid from what is known today. To get an answer, if possible, we must look at the research describing the Flynn effect. But before that, perhaps the following challenging questions should be asked: Could it be that the construction of the mentioned dichotomy (and especially the idea of fluid intelligence) has helped perpetuate the idea that (certain forms of) intelligence are essentially genetically determined?

THE FLYNN EFFECT

When the question arises about whether intelligence, as measured by an IQ quotient, is relatively stable or more modifiable, one cannot escape the "Flynn effect." This effect refers to the fact that IQ is shown to increase across generations. According to Flynn (1987, p. 184), the IQ across 14 different industrialized nations has increased from 5 to 25 points, with an average of 15 points or a full standard deviation over a generation (about 20 nations have been gradually included in the analysis basis). What in a way seems paradoxical and surprising in light of the dichotomy presented above, is that the effect has been more significant on tests believed to measure fluid intelligence (intelligence measured with so-called "culture-reduced" tests such as Raven Progressive Matrices) than for tests believed to measure crystallized intelligence (Flynn, 1999).

Possible proposals put forward to explain the Flynn effect include an improved level of education, increased practice in performing under time pressure, less illness among children, and better nutrition. Flynn (1999) prefers environmental causes in the broadest sense (including education and a society with increasing cognitive challenges) to explain the recorded increases in IQ scores. In any case, it is considered unlikely that genetic mutations

have taken place over such a short period on such a broad basis that they could have had such a marked effect as the one in question.

The IQ progress also turns out to have leveled off and is almost on a slight decline in, e.g., the Nordic countries, as long as the data indicate. In Norway, John Martin Sundet has conducted extensive research on IQ scores using yearly data from Norwegian conscripts starting in the latter half of the 1950s until the beginning of the 2000s – a total of data from well over 900,000 young men. Like Flynn, he has found that intelligence has increased – especially in the first decades of the mentioned period. Sundet has further registered that the IQ scores have stagnated and even had a slight decline from the mid-1990s. Like Flynn, he has also made findings that show that the increase has nevertheless been most significant on tasks that are assumed to measure fluid intelligence compared with tasks that measure crystallized intelligence (Sundet, 2015).

FLUID INTELLIGENCE CAN BE INCREASED

Flynn and Sundet's demonstration that the effect is greater on tests assumed to measure fluid intelligence is in good agreement with data reported by Sternberg (2008). His article with the title "Increasing fluid intelligence is possible after all" refers to the findings of Jaeggie et al. (2008), which document that certain forms of training related to working memory have shown to lead to higher scores on tests that are believed to measure fluid intelligence.

Sternberg also asks the question of why it has taken almost 40 years before such effects have been possible to show in terms of positive impact on scores of fluid intelligence. The answer he arrives at is that this is primarily due to the fact that more current cognitive-based theories about intelligence have created new insight into what kind of training may be relevant. In this context, he points out that it has not been so many years since working memory has begun to be regarded as a key determiner for fluid intelligence.

Referring to Jaggie et al. (2008), Sternberg (2008) sums up that fluid intelligence is trainable to a significant and meaningful level and that the result varies depending on the extent of the training, in that more training leads to more significant "gain." It is also stated that this effect or "gain" can be achieved by training on tasks/problems, which, at least superficially, are not similar to those found on tests that are assumed to measure fluid intelligence.

The relationship between working memory training and the assumption that such training can improve intelligence (especially fluid intelligence) is nevertheless by no means a clarified and uncontroversial matter. There are various findings in this regard. Therefore, it seems appropriate to conclude that possible improvements in working memory as a result of various forms of training do not necessarily lead to positive changes in measures for fluid intelligence.

In this context, reference is made to a recent meta-analytical study regarding the possible effects of various kinds of working memory training (Melby-Lervåg, M. et al., 2016). The Flynn effect (compared to [so far] weak support from some findings on working memory training) suggests that one of the last barriers to considering intelligence as largely dynamic and trainable, rather than more static, seems to disappear when scores on tasks that are believed to represent fluent intelligence are perceived as "trainable".

IQ SCORES AND PREDICTION OF FUTURE SCHOOL PERFORMANCE – CAUSAL INTERPRETATIONS OR CORRELATION INTERPRETATIONS?

When children and young people are referred to educational-psychological services for expert assessment of language and learning difficulties in the areas of reading and writing difficulties, mathematics difficulties, etc. (and/or behavioral problems), it is expected that an

intelligence test/cognitive test is very often also administered. Additionally, observations of, conversations and interviews with the individual in question and with the school and home occur.

The scenario can be as follows: An individual referred with language and/or problems with school subjects is assessed, and (more or less marked) difficulties are found in reading/writing and/or mathematics. An intelligence test/cognitive test is administered. The person obtains a performance or score in the lower average or lower range compared with individuals in the same age group in the standardization sample.

Suppose the test administrator interprets this relationship in a causal perspective in light of the total IQ score. In that case, s/he will be at risk of determining a possible cause of the poor performance in reading/writing and/or in mathematics, namely that a lower or low IQ score allegedly indicates the person concerned has an intelligence that (helps to) "explains" the student's possible low level of performance.

Suppose such an IQ finding is emphasized too strongly in the considerations and communication about what opportunities the individual should have further in his/her schooling. In that case, there is a risk of making incorrect predictions about the student's opportunities. These predictions could negatively affect teachers, parents, and – finally – the student's future performance expectations. These are expectations that may serve as self-fulfilling prophecies for the person/persons concerned in an unfortunate way.

A correct interpretation of a low/lower IQ score compared to poor/poorer academic performance, on the other hand, would be to see this relationship in a correlation perspective and not in a causal view. This view could (in many cases) lead to a different interpretation and more positive prediction of the possibilities a student has in the future – compared with the total information one has from the report in general, which should also include a summary of the "educational history "available to the student.

The logic of this correct conception of relation probably also emerges more clearly if one knows how much explanatory part intelligence measured by IQ has for predicting performance in the future. If you look at the frequently used intelligence test WISC-IV – which is believed to show strong correlations between IQ and predictions regarding school performance – general intelligence explains only approx. 25% of the variance (Kuncel, Hezlett & Ones, 2004).

Motivation as a factor can explain an approximately equal part of the variance (Steinmayr & Spinath, 2009). In other words, most must be explained by other factors. All in all, there is obviously a great "opportunity" here for educational-psychological measures.

“KILLING THE PREDICTION"

Although the well-known cognitive test the WISC-IV has changed a lot since the "earlier" edition of the WISC-R, the first variant of the WISC test that was standardized based on Norwegian conditions, it may still be interesting to convey what Alan Kaufman once expressed in connection with how the WISC-R should be optimally interpreted when children/students score poorly:

> *Intelligence tests are good predictors of school achievement, providing one justification for using them in an academic setting. However, intelligence test scores should result ultimately* ***in killing the prediction*** *(my emphasis). The fact that most children who score very poorly on the WISC-R will also do poorly in school* ***should not be accepted as a statement of destiny*** *(my emphasis). Judicious test interpretation and translation of test findings to action can alter what is sometimes treated as inevitable; when cast in this role, the intelligence test can justifiably be termed a 'helping agent'. (1979, p. 14)*

By the way, I would like to draw your attention to the fact that two of Alan Kaufman's books, on the WISC-R (1979) and the WISC-III (1994), respectively, actually have the title "intelligent" testing – with the WISC-R/WISC III and not "intelligence" testing. The same is the case with the title of Kaufman, Raiford, and Coalson's book on WISC-V (2016). Kaufman also collaborated with David Wechsler (1896–1981), the original developer of the Wechsler tests, on the preparation of the WISC-R. Kaufman's books from 1979 and 1994 have been widely used in the interpretation of test results of the mentioned Wechsler tests, which is probably also the case with the mentioned WISC-V book from 2016. The titles reflect that Kaufman also focused on (testing and) interpreting intelligence in an intelligent way so that the tests could really appear as "a helping agent."

In this way, they could cause/contribute to developing measures to increase children's/students' learning outcomes and thus their further basis for learning. In other words, poor performance on the WISC-R measurements should lead to the development of measures aimed at a positive change in the current development trend that poorer/worse scores seem to predict. Here again, it can be stated that the WISC-IV, which is the version used in Norway today, is significantly changed in its structure compared to the WISC-III, without this necessarily making the content of Kaufman's quote above no longer worth taking into account. (A short comment: after the publication of this article in 2017, the WISC V became available for use in Norway.)

INTELLIGENT TEACHING AND CORRESPONDING LEARNING IN TERMS OF A PROPOSED MEASURE

In light of what has been pointed out concerning intelligence as the general theme and ability to learn, I choose to close this article using an educational-psychological approach that has already been discussed a little in this article, Nyborg's method of Systematic Concept Teaching. This research-based and well-documented approach (cf. Hansen [Ed.] [2017, Chapter 3] and Hansen & Morgan [2020, Chapter 1]) can, in many cases, have a significant impact on children/children/students' ability to learn and their learning outcomes if it is implemented in preschool and other school settings on a broad basis.

In my opinion, this is an approach that employees in the educational-psychological services and other agencies tasked with assessing and advising on educational-psychological measures should have good knowledge of and consider in their recommendations to teachers.

Nyborg's view (1993, p. 488) is that the teacher – within Systematic Concept Teaching as a measure – will be able to implement what can be described as *intelligent teaching and corresponding learning.* Essentially, this term denotes teaching that brings about *good understanding during learning* (Latin intelligere: to understand). It further means that what is *clearly understood and coherently learned* – in terms of conceptual systems and principles – can usually also be remembered very well. Consequently, this means teaching concepts so that they can simultaneously be integrated in different ways into hierarchically organized conceptual systems and propositionally organized descriptions, explanations, principles, definitions, formulas, rules, etc. All of these are necessary for the transfer of learning, i.e., a process that can significantly accelerate further learning.

The previous section's content in many ways represents what one often associates with the main features of good cognitive and intelligent functioning.

A THREEFOLD DIVISION OF THE DISCUSSION OF THE PROPOSED MEASURES

For the sake of clarity, a distinction is made between three "levels" in the further presentation of the measure:

1. *Systematic Concept Teaching – the framework in terms of four models*
2. *Systematic Concept Teaching – what, how, why*
3. *Systematic Concept Teaching – a well-proven educational-psychological practice*

SYSTEMATIC CONCEPT TEACHING – THE FRAMEWORK IN TERMS OF FOUR MODELS

The approach of Systematic Concept Teaching stands for a comprehensive theory of learning and development as well as a corresponding educational-psychological practice developed by Magne Nyborg in collaboration with R. H. Nyborg and several other colleagues, including Andreas Hansen (i.e., 1987, 2006). Nyborg's theoretical and empirical research has resulted in the development of four models for use in educational thinking, planning, and measures within the tradition of Systematic Concept Teaching:

1. ***The PSI model*** *(Person-Situation-Interactions during learning): This is a theoretical model of a learning person in terms of a depicted presentation of central parts of Nyborg's learning theory. Very concisely, this is a theory where learning as a factor in development is central, and in which verbal language and conceptual learning and the importance of language for the interpretation of subsequent learning are strongly emphasized.*

   Particular emphasis is placed on the role that Basic Concept Systems (color, shape, position, size, pattern, etc.) and related basic concepts can have for subsequent learning and development as tools for making analyses, comparisons, and abstractions.

   In other words, it is also about a depiction of representation of psychological processes (sensation and sensory memory, coding [interpretation], short-term memory/working memory, thinking and problem-solving) and long-term memory structures (knowledge, skills, emotional and motivational dispositions) in a learning person in dynamic interaction with her/his surroundings. In this way, the PSI model also appears as a model of an information-receiving and information-processing system.

   In light of this, the PSI model can, for example, be used as an analysis tool concerning what happens when children and young people do not learn satisfactorily. In addition, it can also be used for an analysis of which prerequisites of learning should be taught from an early, preventive perspective as well as from "a remediating of learning difficulties" perspective.

2. ***The BCS model:*** *This model represents an inventory of words for Basic Concept Systems (BCSs) and examples of words for related basic concepts.*

3. ***The SCT model*** *(The model for Systematic Concept Teaching = The SCTM). This model represents psychological and educational principles for teaching BCSs and related individual basic concepts. It is also considered valid for teaching more complex conceptual systems and related individual concepts, including what can be described as academic concepts.*

4. ***The model for teaching skills.*** *As the name suggests, this is a model describing how one can facilitate the learning of skills in a precise way. This includes the learning of both verbal skills (speech perception s., that is, the recognition of linguistic units, speech s., reading s., and writing s.,) and non-verbal skills (e.g.*

recognition of melodies; walking, cycling, diving, writing; playing to notes, dancing to rhythms, etc.).

The interested reader can find a thorough description of the framework of Systematic Concept Teaching in Hansen & Morgan (2020), including chapters on teaching reading, mathematics, and school subjects in general. Chapter 11, with its descriptions of seven example case studies, deserves to be mentioned, as well. This book goes "hand in hand" with Hansen & Morgan's website: www.sctresource.com, in which one can find a variety of materials related to how to undertake Systematic Concept Teaching for children and youth with diverse kinds of learning difficulties.

|The year that the book of Hansen & Morgan (2020) referenced in this article was published, informs the reader that it "was written into" this article after its original publication in the Norwegian journal of Psychology in the Municipality in 2017. In the original version of this article published in Norwegian, the source referred to for more reading about Systematic Concept Teaching was Hansen (Red.) (2017).

SYSTEMATIC CONCEPT TEACHING – WHAT, HOW, WHY?

Systematic Concept Teaching or SCT refers in its first stage to the teaching of Basic Conceptual Systems (BCSs)(Color, Shape, Size, Position, Place, (Surface) Pattern, Direction, Number, Time, etc.) and their related basic concepts, which are made verbally conscious to the children/students by means of oral language skills. From 20 to 26 BCSs are taught depending on how they are being grouped.

These Basic Conceptual Systems and their related basic concepts (conceptual vocabulary) are taught utilizing the Model for Systematic Concept Teaching (the SCTM), which Magne Nyborg initially developed. Later, it was further developed by Andreas Hansen with two additional procedures.

Systematic Concept Teaching aims to help children/students develop positive expectations towards their own learning.

SCT also seeks to teach children/students to direct and take control of their attention, training them to prolong and expand their short-term memory (STM) and working memory (WM) by consciously applying language in these processes (outer as well as internalized private speech).

Moreover, SCT makes children/students aware of and trains them to use language as a tool for further thinking, learning, and problem-solving.

Another essential aim of Systematic Concept Teaching is to teach children/students how to learn more effectively, which can be seen as an outcome of some of the other points.

SCT also includes training children/students to apply a precise and decontextualized (or situational independent) language – when needed in communication, thinking, and learning.

In the final stage of SCT, both Basic Conceptual Systems and more Complex Conceptual Systems with their related conceptual vocabulary are deliberately applied as tools for teaching school subjects and skills of different kinds at increasingly higher levels.

SCT is recommended for use (in a modified manner) with children/students from the age of (3) 4–5 years and upward, according to their individual needs, in preschool and other school settings, and even into adulthood if needed.

SYSTEMATIC CONCEPT TEACHING – A WELL-PROVEN EDUCATIONAL-PSYCHOLOGICAL PRACTICE

What further makes the mentioned approach particularly interesting is the educational-psychological practice developed based on the mentioned framework with four models for use in educational thinking, planning, and teaching practice. Extensive teaching proposals have been developed, and empirical data have been gathered from educational interventions, showing positive results in different thematic areas such as language training, mathematics training, reading and written language training. The same is the case in the teaching of school subjects in general, e.g. M. Nyborg, 1971; E. M. Såstad, 1975; T. Lyngstad & M. Nyborg, 1977; M. E. Seljebø, 1980; R. H. Nyborg, 1983; M. Nyborg, (Ed.) 1985, 1989, 1994, (Ed.) 1994; M. Nyborg, & R. H. Nyborg, 1990a, 1990b, 1995, 1996; G. Sønnesyn & M. Hem, 1996; G. Sønnesyn, 2009; A. Hansen, 1987, 1991, 2001, 2006, (Ed.) 2017; A. Hansen, K. Koppen & A. Svendsen, 2016; T. Karstad, 2011; S. Nyborg, 2017; A. L. Johnsen & E. Natås, 2017; A. Hansen & K. Morgan, 2020.

WHAT IS NEEDED TO HAVE SYSTEMATIC CONCEPT TEACHING IMPLEMENTED ON A BROAD BASIS IN PRESCHOOL AND OTHER SCHOOL SETTINGS

If recommendations about SCT are to be received positively in preschool and other school settings, it is crucial that staff in these institutions have acquired knowledge of SCT as a measure both from an early, preventive perspective as well as from a remediating perspective (when this is needed). This knowledge can, to some extent, be developed by providing continuing education in regards to SCT, but this is not really the case when it comes to the "big picture". In the long run, knowledge about and use of SCT in preschool and other school settings can only be fully disseminated if this becomes part of teacher studies in general. A proposal for what (all) teacher studies in this perspective ought to contain is pointed out in Hansen (Red.). (2017). As such, this book represents an "entrance" to the theoretical and practical knowledge of SCT as an educational (/psychological) approach.

Hansen & Morgan's book from 2020 in English covers even more of the SCT approach, from both a practical and a theoretical point of view. Important chapters to start with are Chapter 1 with a good review of what SCT is, what kind of children can benefit from it, etc., Chapter 11 on example Case studies on SCT, and Chapter 3 on the Systematic Concept Teaching Model (The SCTM). Also, Chapter 4 and Chapter 6, respectively, on possible proposals for teaching Basic Conceptual Systems (BCSs) and the Inventory of BCSs are important stuff to start with.

CONCLUDING REMARKS ON SYSTEMATIC CONCEPT TEACHING, INTELLIGENCE AND IQ

This article discusses the view of several scientists from the early part of the 20th century to the present time who perceive intelligence as dynamic, malleable, and changeable. It is argued that intelligent teaching in terms of SCT can, in many cases, have a significant impact on the development of children/students' learning ability and learning outcomes.

Indirectly, it will follow that SCT can contribute to the development of children's/students' intelligence, defined as the ability to learn. In this context, it may also be appropriate to provide information on how IQ as a measure of intelligence has demonstrably developed in a small number of children/students who have received SCT over several years (3–5 years). Several years of SCT is an essential criterion in this context because contributing to a clear positive change in IQ (as a by-product of the development of learning prerequisites and develop learning ability together with further learning of school subjects and further skill learning) requires comprehensive measures implemented over several years. This is a view

that is consistent with Howe's (1997) argument regarding what it takes to increase a person's IQ score:

> *That is not to deny that raising a person's IQ is a substantial task. Because an intelligence test samples a number of different cognitive capabilities, more knowledge and more skills have to be gained in order to increase a person's IQ score than is necessary to improve narrower abilities to a comparable extent. (p. 141)*

Two individuals who have carried out longer studies with SCT, in which there have been opportunities to measure possible effects in terms of changes in IQ, as expressed in comparisons of pretest-posttest results, are Ragnhild Hope Nyborg (1938–1996) and Andreas Hansen, the author of the present article. R. H. Nyborg (1983, 1995 December, discussed in Hansen, 2006, and Hansen & Morgan [2020]), reported significant changes in IQ score (on the ability test WISC-R), with increases from approx. 20 to about 40 IQ points over four years with SCT. Hansen (1995 December, discussed in Hansen, 2006), for his part, reported on a case with SCT over four years with a registered increase in IQ (WISC-R) of 35 points after three years. Hansen (2006) also reported increases of approximately 10 IQ points over an intervention period of 2 years with SCT for five cases reported on and discussed in his doctoral dissertation. A relatively comprehensive discussion of intelligence and experiences with changes in learning ability resulting from SCT, compared with IQ scores, can also be found in Hansen (2006, available online in Norwegian), Chapter 3, and Chapter 10.2.

Many uncertainties are related to IQ measurements and the results obtained. Although IQ is considered by many to be (relatively) stable, the mention of findings with significant changes in IQ at individual levels is not an unusual phenomenon either. An interesting example of this comes from research conducted by Sue Ramsden et al. (2011). She and her colleagues performed research regarding changes in IQ in "33 healthy" teenagers. These were first tested in 2004 when they were between 12 and 16 years old and retested four years later when they were between 15 and 20 years old. Some of the young people improved their test results by as much as 20 points on the standardized IQ scale used, while others of the young people did correspondingly worse. No specific interventions were implemented in connection with this study. The study, which also included scanning of the participants' brains, is so interesting that it is recommended for reading.

In the same way that intelligence, when defined as the ability to learn, must be perceived as dynamic and changeable, there are indications that IQ as a measure significant changes over the years. This is knowledge that one should strongly consider when interpreting the results on IQ tests, when communicating expectations about future opportunities for children/students to their parents, their preschool and other school settings, and when advising what educational-psychological measures should be appropriate.

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A comment in addition to the references, which serves as a kind of positive validation of Systematic Concept Teaching, can be found in the article: **Cognitive Early Education,** written by the recently deceased **H. Carl Haywood (2020)**
https://doi.org/10.1093/acrefore/9780190264093.013.971
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