DIGITIZED NATIONAL TESTS IN MATHEMATICS: A WAY OF INCREASING AND SECURING EQUITY?

Anette Bagger[1], Eva Norén[2], Lisa Boistrup[2], Christian Lundahl[3]

[1]Umeå University, [2]Stockholm University, [3]Örebro University

On one hand, the Swedish governing discourse on equity in the context of digitizing education portrays modernization, progress and democracy as a foundation in the equity work. On the other hand, in the context of digitized tests, equity is rather framed within a neoliberal logic while related to all individuals' possibilities of choosing a 'good life', and to compete on equal terms. Not all disadvantaged groups are the target, though. It is mainly boys who are supposed be given better grades, and, in addition, students with disabilities who are supposed to (as far as possible) be able to have the opportunity to show their knowledge during the test. Language or socioeconomically diverse settings are not mentioned with regard to digitized national tests.

INTRODUCTION

Today, common 'vehicles' for development and learning in school are digitization and technology (Hylén, 2013). Data use in education is a regime of governing who derives from the idea of educational transparency (Prøitz, Mausethagen & Skedsmo, 2017). Regulatory practices trough increased surveillance is rooted in a neoliberal logic and might increase inequalities (Apple, 2000). At the same time as digitalization are frequently used in measuring and securing educational quality, the effects from digitization are understudied (Goodman, Seymor & Andersson, 2015). Another vehicle for progress and well-fare in Sweden, besides digitizing, is the extensive and national assessment of students' knowledge. These tests are both the object of governing strategies and part of the means to govern the education system (Ozga, 2009). National assessment is mandatory in primary school in Sweden, in the years 3, 6 and 9, and have until now been performed with paper and pencil. The two vehicles, national assessment and digitizing, are now put together by the government as the Swedish National Agency for Education has been given the assignment to digitize all Swedish national tests by the year 2022. This course of action is, among other things, assumed to enhance equity and fairness (prop. 2017/18:14; U2017/03739/GV).

Despite the use of equity as a frequent educational argument, while addressing change and development, the meaning of the notion of equity in relation to digital testing is often shadowed and multitudinous and might actually mean very different things (Espinoza, 2007). However, in the long run, the interpreted and expressed meaning of equity will direct the actions of and approaches towards individuals, since values are connected to concepts (Llewelyn & Mendick, 2011). To take account of what policymakers mean by and how the concept of equity is communicated is of great interest since this governs what equity is and could be. The purpose of this paper is to contribute with knowledge regarding aspects of equity in the governing of digitizing national mathematics tests in Sweden. The investigation is guided by the following research questions. RQ1: What discourses of equity are constructed in policy texts on digitization of National Tests (NT) in mathematics in Sweden? RQ2: What do these discourses of equity contribute to?

EQUITY IN EDUCATION

To legitimate valuable knowledge is and has been a social issue (Berger & Luckmann, 1967). Features like what knowledge is being taught; what is going to be assessed; and what the organizational arrangements are, are embedded in political power structures (Hutmacher, 2001). Unterhalter (2001) draws out how equity can be understood in education, while pointing to the ideal of respect for all. She also addresses that the term equity is not clearly defined in research literature, leading to normative assumptions about equity in education. In line with the definition of equity in the Oxford English Dictionary (2018) we define the term to be 'the quality of being equal and fair'. Thus, equity has to be thought of as a process of making equal and fair, in other words, "equality turned into an action" (Unterhalter, 2001, p. 416). Furthermore, Unterhalter suggests that equity can be understood as a process from 'above', the 'middle' or 'below'. In this paper, equity is pursued from 'above', in the Swedish policy texts we are examining, as a way to govern equity and fairness actions according to rules. This is especially interesting to scrutinize since the Swedish education system is presumed to allocate resources fair and equal, to ensure the same opportunities for all, regardless of birth, social class and ethnicity. (National Agency for Education, 2018)

EQUITY AND DIGITAL ASSESSMENT IN MATHEMATICS

Results from digitized national test are considered to increase transparency and allow discharge through the assessment in the sense of surveillance inspections (Thompson & Cook, 2015). This approach holds the belief that the development of surveillance technologies overrides the capacity of human capital to ensure validity, equity and quality (Piketty, 2014). Researchers have previously pointed out how testimonials derive from the preference that teachers and knowledge need to be monitored in order to be legitimate (Mickwitz, 2015). This can in the digitized test-form also be applied to the test constructors since data on the validity and suitability of the construction will be gathered in the digital system. O'Keeffe (2017) argues that through this, digital samples not only collect and produce data, they also make sense of what capability or skill might be.

There are some comparisons made regarding how computer-based versus paper and pencil-based tests affect different students' opportunities to achieve and participate. Spiezia (2009) notes that students from families with larger economic, cultural, social and technical resources are getting better results at the same level of IT use compared to students with lower socio-economic backgrounds. In addition to this, a Norwegian study has shown that in addition to socio-economic background, language background and motivation is crucial (Hatlevik, Ottestad & Throndsen, 2015). There are other studies (see, for example, Shapley, Sheehan, Maloney & Caranikas-Walker, 2009) which show the opposite, i.e. that socio-economically disadvantaged students achieve equally beneficial mathematics results as students from more advantaged conditions when using digital tools. In addition, Shapley et. als' (2009) point out that both student groups were far more technically skilled than students who went to schools that were not as computer-intensive.

A parallel can be drawn to a study showing that students' prerequisites play a part in the ability of the digital examination to function formatively. Students with higher goal achievement had better opportunities to demonstrate their mathematical skills in a digital examination. An important element was the feedback the pupils received and that it adapted to the students' ability (Faber, Luyten & Visscher, 2017). In addition to this type of adaptation, it is crucial that the examination/test conforms to the students' ability in manners that allows them to access the content. This, together with the opportunity to take the test at one's own pace, seem to be beneficial for digital mathematics test (Landau, Russell, Gourgey, Erin, & Cowan, 2003). Research has also shown that the results of computer-based tests are similar to the ones reached with paper and pencils with the same students (Siozos, Palaigeorgiou, Triantafyllakos & Despotakis, 2009). Another comparison between the two forms has been made in Singapore with 11-12-year olds. A conclusion was that students' viso-spatial thinking and ability had a greater impact on the digital test (Logan, 2015).

THEORETICAL FRAMING

Practices in institutionalized fields, like making (political) decisions and writing policy texts, are in this paper understood in terms of discursive practices (Foucault, 1988). Policy texts on education intend to steer curriculum and classroom practices, and curriculum can be considered to be the system's view of the ideal situation in which it functions (Cummings, 2013). Governmental decisions and documents are in this paper understood as *inscription devices* for the inherent meaning and values held by the concept equity in the context of digitized tests (Popkewitz, 2004). Following from this, these texts are inscribing meaning (see Popkewitz, 2004), norms and values into other discursive practices as for example the practice of assessing knowledge. Thereby, they govern prerequisites in relation to students' participation. Educational reforms are in this way grounded in and built on visions of what is desired in society. Statements in policy texts embody ideas about "how to see, think and act" (Popkewitz, 2012, p. 177) towards people, and thereby they function as governing technologies. That is, they construct certain kinds of people, who that person is and should be. Consequently, they work their ways into the lives of people, for example students, and reinforce a way of thinking of oneself (Foucault, 1983). The notion of discourse is in this paper used to explore how equity is thought about and acted on in the texts on Digitization of the National Tests in Mathematics (from now on abbreviated DiNTM).

EXAMINING POLICY TEXTS

Initially we selected eight governmental texts including the preparatory work, the decision and assignment of implementation given to the Swedish National Agency for

Education (see table 1). In addition, the overall national strategy to digitalize the Swedish school is included, as it precedes and have a strong bearing on the digitalizing of national tests, and also the proposition following from an evaluation of the national assessment and in which equity was highlighted. The policy texts are viewed as discursive practices (Foucault, 1972), since texts build on existing discourses and are written within the discursive practice to write policy texts. All sections of the texts referring to equity in the context of digitized tests were selected, as well as sections that addressed equity without mentioning the term digitization specifically.

Table 1: Overview of the governmental documents analyzed in this paper

No	Kind of source and title	Short description
1	Memo: *Nationella prov: rättvisa, likvärdiga, digitala.*	A PM, where the government announce the proposition on an investigation of the national assessment system in regard to fairness, equality and digitalization.
2	Proposition: *Nationella prov: rättvisa, likvärdiga, digitala.* (Prop. 2017/18:14).	62 pages of proposition, the same as was announced in the PM above
3	Memo: *National strategi for digitaliseringen av undervisningen*	A PM, where the government announce a national digitalization strategy of education, stating that children and students have to reach a high level of digital competence, which is connected to equity.
4	Information: *För ett hållbart digitaliserat Sverige – en digitaliseringsstrategi*	Information about a strategy about how Sweden will be the best in the world to take advantage of the potential of digitization trough the goals: digital - competence, -security, -innovation, -management and – infrastructure.
5	Strategy*: För ett hållbart digitaliserat Sverige – en digitaliseringsstrategi.* (N2017/03643/D)	14 pages strategy about equal access with regards to students needs and prerequisites, and effective use of technologies. Writings about digital equity are included.
6	Memo: *De nationella proven digitaliseras*	PM regarding the governmental decision to digitalize the national tests and the approval of the previous mentioned proposition (prop 2017/18:14)
7	Memo: *Uppdrag att digitalisera de nationella proven mm.*	A PM to the National Agency of Education, which has to ensure the accessibility of the national tests and that they can be used by all students.
8	Assignment: *Uppdrag att digitalisera de nationella proven mm.* U2017/03739/GV	4 pages assignment stating that digital test will lead to a higher level of equity because the grades become fairer. The assessment system has to be modernized.

In a first analytical step, we repeatedly and carefully read the selected texts, independently by the each other, with the aim of summarizing and organizing. The texts were then compared and scrutinized, looking for patterns, contradictions and similarities. Key words that often appeared were identified. The second step included thematization of the key words. The theoretical constructs *discourse* (Foucault, 1970/1993; 1972) was used to elaborate on how equity in the context of DiNTM is discursively constructed through the policy texts. Specifically, we construed discourses that order and shape how equity is to be realized in DiNTM. Below, we address RQ 1: that is, the equity discourses we construed based on the analysis of the policy texts, while drawing on quotes from the policy texts to support our results.

CONSTRUED EQUITY DISCOURSES

It is no doubt the Swedish government and parliament address digitizing and democracy as intrinsically dependent on each other. For example, the first line in the National Strategy for Digitizing Education is: "Digital competence is basically a democracy issue" (text (t.) 4, p. 3). According to the press message the aim of the digitizing education is that:

> Sweden will be the best in the world to take advantage of the potential of digitizing. Education policy has an important role to play in achieving this ambition. The government has therefore developed a national digitization strategy for the school system. (text from memorandum on the web, no pages indicated)

In the digitizing strategy (t. 5), the government describes a foundation for continued work to use the potentials of digitization to raise both students' achievement and *increase equity* in the school system. However, when analyzing the policy documents in relation to digitizing tests, equity is discursively constructed in various ways. Four discourses were construed from how policy texts constructed the concept of equity:

1. **Equity as threatened and deficit**

Equity is constructed as *threatened* by flaws in the assessment system and as constituting the very legal rights in the assessment of knowledge. The minister in charge fabricates flaws as the reason for digitizing tests, and the modernized digital system as a solution leading to a higher level of equity as the grades become fairer:

> … now we will get better order and remedy when grading and in student's knowledge assessment. There are now good conditions for the assessment of test results, and in the end assessment can be done in a more equal way for all students. Digitizing the national tests is an important and long-awaited modernization. (t. 6, PM on the web, no pages indicated)

The flaws are partly due to teachers as producers of inequity since teachers' judgments are described to be too mild when assessing their own students:

> teachers who assess their own students' test answers tend to make generous assessments and put relatively high test scores (t. 2, p. 13).

This is described as supposedly more common if the teacher works alone and also something to contravene with the opportunity in digital tests to make students anonymous:

> … in order for the pupils to perceive less that the assessment is unfair, the proposition suggests that student solutions of the national tests should be unidentified in the assessment in cases where the tests have been carried out on computer (t. 2, p. 48)

Equity is also described as *needed* between boys and girls, through gender equality in regard to the tests' impact on grading, and for students with disabilities. Equity for the former group is at the same time described as a possible threat by the system, which is connected to how the test might be designed.

> In order to ensure that students with disabilities will take part of the positive effects, the technical solutions must be designed to suit all students and that the student's individual needs will be carefully investigated. (t. 2, p. 31)

2. Equity as access

The design of the system might threaten equity as described in the discourse above. Continuing this argument, for students with disabilities, equity is further emphasized as access. Adaptations and also that the technical and digital setting suits everyone, which is described as crucial. Equity in the digital production and transformation of the test is relying on international, special educational and digital expertise.

> Additionally, there should be experts in the group that take particular account of the needs that students with disabilities may have. (t. 2, p. 40)

Equity as access is also stated in text 8 as students with disabilities are addressed, after mentioning "all students':

> ... strive to ensure the accessibility and usefulness of the test for all students, including students with disabilities, in order not to limit the student's ability to demonstrate his or her knowledge in the test situation. (t. 8, p. 3)

3. Equity as justice in grading

Equity is discursively constructed from the documents as justice in grading, something that needs to be monitored and fixed through the governing of teachers' assessment of the tests. The tests will have the sole purpose of governing assessment towards equality and not be used for evaluating teaching. The tests are thereby being enhanced for the purpose of a governing technology of grading and assessment:

> As the national tests will have the purpose of being supportive for grading, the criterions for evaluation will be the same in the correction of national tests and grading. (t. 2, p. 28)

Equity is overall expected to be achieved if the teachers' knowledge about students and the relations between them, is taken out of the equation when answers are evaluated.

The equity is then described as increased if the tests should be self-correcting instead:

> Student solutions of national tests should be assessed by someone other than the teaching teacher. Student solutions on digitized national tests should be unidentified. (t. 2, p. 14)

The need for taking these steps is referred to as flaws in stability over time and differences between tests in regard to how they are assessed and how heavy they are considered for the grades in the subject. A levelling of these aspects would especially contribute to equity in grading in favor of boys since teachers are more likely to give a girl a higher grade, regardless of the test:

> Unidentified student solutions are deemed to increase the possibility to equity between boys and girls…girls are in a higher degree getting a higher final grade then the grade on the test. (t. 2, p. 22)

Another statement is that the equity will be better secured in the future, since the tests' sole purpose will be to determine the grade, and not, like previously, to also contribute to an evaluation of the teaching

4. Equity as equal competition

A final goal of the above depicted access and justness, in order to achieve equity, is to improve equity in regard to competition. Equity is thereby discursively constructed as being about fair competition. This would ensure that the students are competing on equal terms regarding higher education.

> This provides for increased legal certainty for the students when they can compete on the basis of more equivalent conditions when applying for higher education. (t. 2, p. 30)

DISCUSSING DISCOURSES OF EQUITY

We are here addressing RQ 2. Four discourses were demarcated in the texts. What do these discourses of equity contribute to?

These discourses contribute to a narrative in which equity initially is threatened and viewed as missing, and something that firstly needs to be met through creating access to the tests for all students. Further on in the narrative, is a pull away of teachers and relations from the evaluation. This will supposedly lead to just grades and the essential objective: equal opportunities to compete in future life and higher education. In relation to digitized tests, equity is both a mean and a goal.

However, the analysis of the policy texts denotes that f. ex. the discourse 'equity as threatened and deficit' relies on a normative assumption (Unterhalter, 2001) about teachers not being fair enough in their assessment of their own students. They are made-up as too generous in the texts. The teachers have to depersonalize themselves to make the assessment fair. Regarding an imagined increased transparency and discharge through the assessment, we see a risk that the processes of digitizing the national test will become a full-scale surveillance checkup (Thompson & Cook, 2015), also of the not trusted teachers. We can also see a risk of Shapley et. al.'s (2009) point, that student groups who are more used to technology than others will gain more on DiNTM than students who not are used to digitized tests or digital tools. The discourse ‘equity as access’ will not be realized at all if not, as described in the digitizing strategy of education, all students have the opportunity to develop digital competencies. Thus, and counter productively, an expected positive impact of digitization may be negative to certain groups of students. Our argument, leaning on Siozos et al.’s (2009) findings, is that the policy texts’ reason for equity is not sustainable.

In the new national system for assessment, equity seems to be week and in need of fixing. Equity “is” corrupted by relations and personal or identity factors. Especially ‘the lonely teacher’ is a “problem”. Equity is further emphasized as something that the teacher produces and not something the student “has”: a circumstance that leads to possible serious future consequences and to a view of students as passive receivers without agency. Thus, equity is constructed as something that needs to be governed by the state - and trough disciplining the teacher, and possibly by teachers governing each other. The access is further described as dependent on needs and prerequisites, which implies that equity is not at all sameness. At the same time equity is frequently described as sameness – same opportunities to display knowledge, same grading, same opportunities to be evaluated, same judgement in assessing tasks etc. All together the concept of equity is ambiguous, and it is actually not defined the schools a very interpretable and wide assignment to meet.

In the Swedish context of digitizing the national tests in mathematics, equity is rather framed within a neoliberal logic while related to all individuals’ possibilities of choosing the ‘good life’, and to compete on equal terms (Llewellyn & Mendick, 2011). A further exploration of how the tests are constructed and thereafter realized in the various settings would be an interesting follow-up study. As well as an in-depth study of what happens in the classroom and the assessment situation when the tests goes digital, and then paying attention to different prerequisites in the schools’ culture and the individuals’ experiences and competencies. Especially since effects from the digitized classroom is very under-researched (Goodman, Seymor & Andersson, 2015).

REFERENCES

Apple, M. W. (2000). Mathematics reform through conservative modernization? Standards, markets, and inequality in education. *Multiple perspectives on mathematics teaching and learning*, 243-259.

Benadusi, L. (2002). Equity and education. In *In pursuit of equity in education* (pp. 25-64). Springer, Dordrecht.

Berger, P., & Luckmann, T. (1967). The social construction of reality. London: Allen Lane.

Cummings, W. K. (2003). *The Institutions of Education: A comparative study of educational development in the six core nations*. Didcot: Symposium.

Espinoza, O. (2007). Solving the equity–equality conceptual dilemma: a new model for analysis of the educational process. *Eductional Research*, *49*(4), 343-363.

Faber, J. M., Luyten, H., & Visscher, A. J. (2017). The effects of a digital formative assessment tool on mathematics achievement and student motivation: Results of a randomized experiment. *Computers & education, 106*, 83–96.

Foucault, M. (1970/93). Diskursens ordning: Installationsföreläsning vid Collège de France, 2 december 1970. Stehag: B. Östlings bokförlag. Symposion.

Foucault, M (1972). The archaeology of knowledge: And the discourse on language. New York: Tavistock publications limited.

Foucault, M. (1988). Technologies of the self. In L. H. Martin, H. Gutman, & P. H. Hutton (Eds.), Technologies of the self: A seminar with Michel Foucault (pp. 16-49). London: Tavistock.

Goodman, Seymour, & Anderson. (2016). Achieving the performance benefits of hands-on experience when using digital devices: A representational approach. Computers in Human Behavior, 59, 58-66.

Hatlevik, O. E., Ottestad, G., & Throndsen, I. (2015). Predictors of digital competence in 7th grade: a multilevel analysis. *Journal of Computer Assisted Learning*, *31*(3), 220–231.

Hutmacher, W., Cochrane, D., & Bottani, N. (2001). *In pursuit of equity in education: using international indicators to compare equity policies*. Springer Science & Business Media.

Hylén, J. (2013). Digitalisering i skolan–en kunskapsöversikt. *Ifous rapportserie 2013*, *1*.

Landau, S., Russell, M., Gourgey, K., Erin, J. N., & Cowan, J. (2003). Use of the talking tactile tablet in mathematics testing. *Journal of Visual Impairment and Blindness*, *97*(2), 85-96.

Llewellyn, A., & Mendick, H. (2011). Does every child count? Quality, equity and mathematics with/in neoliberalism. In B. Atweh (Ed.), Mapping Equity and Quality in Mathematics Education (pp. 49–62). Springer Science & Business Media B.V

Logan, Tracy. (2015). The Influence of Test Mode and Visuospatial Ability on Mathematics Assessment Performance. *Mathematics Education Research Journal, 27*(4), 423-441.

Mickwitz, L. (2015). Den professionella lärarens möjlighetsvillkor. *Utbildning & Demokrati*, *24*.

Norén, E. (2017). En skola för alla? In (Eds.), L. Björklund Boistrup, M. Nordlund & E. Norén, *Alla människors möte borde vara så. Vänbok till Astrid Pettersson.* Stockholm: Stockholms universitet.

O'Keeffe, B. (2017). *Faith, Culture and the Dual System: a comparative study of church and county schools*. Routledge.

Ozga, J. (2009). Governing education through data in England: From regulation to self-evaluation. *Journal of education policy*, *24*(2), 149-162.

Oxford English Dictionary (2018). Retrieved May 20th at: https://en-oxforddictionaries-com.ezp.sub.su.se/definition/equity

National Agency for Education (2018). Retrieved May 20th at: https://www.skolverket.se/skolutveckling/vardegrund/jamstalldhet

Piketty, T. (2014). Capital in the 21st Century. Princeton: Belknap Press.

Popkewitz, T. (2004). The Alchemy of the Mathematics curriculum: Inscriptions and the Fabrication of the child. American Educational Research Journal (41)1, 3-34.

Popkewitz, T. (2012). Numbers in grids of intelligibility: making sense of how educational truth is told. In H. Lauder, M. Young, H. Daniels, M. Balarin & J. Lowe, (Eds), Educating for the Knowledge Economy? Critical Perspectives, (pp. 169-191). Routledge, Taylor & Francis Group.

Prøitz, T., Mausethagen, S., & Skedsmo, G. (2017). Data use in education: Alluring attributes and productive processes. Nordic Journal of Studies in Educational Policy, 3(1), 1-5.

Román, H., Hallsén, S., Nordin, A., & Ringarp, J. (2015). Who governs the Swedish school? Local school policy research from a historical and transnational curriculum theory perspective. *Nordic Journal of Studies in Educational Policy*, *2015(1)*.

Shapley, K., Sheehan, D., Maloney, C., & Caranikas-Walker, F. (2009). Evaluation of the Texas Technology Immersion Pilot: Final Outcomes for a Four-Year Study (2004-05 to 2007-08). *Texas Center for Educational Research*.

Serder, M. (2015). *Möten med PISA: kunskapsmätning som samspel mellan elever och provuppgifter i och om naturvetenskap*. Malmö högskola.

Siozos, P., Palaigeorgiou, G., Triantafyllakos, G., & Despotakis, T. (2009). Computer based testing using "digital ink": Participatory design of a Tablet PC based assessment application for secondary education. *Computers & Education*, *52*(4), 811-819.

Spiezia, V. (2009) Assessing the impact of ICT use on PISA scores. OECD, Paris.

Swedish Government (2017a). *Nationella prov – rättvisa, likvärdiga, digitala.* Prop. 2017/18:14. Stockholm: Utbildningsdepartementet.

Swedish Government (2017b). *Uppdrag att digitalisera de nationella proven m. m.* U2017/03739/GV. Stockholm: Utbildningsdepartementet.

Thompson, G., & Cook, I. (2015). Becoming-topologies of education: Deformations, networks and the database effect. *Discourse: Studies in the Cultural Politics of Education*, *36*(5), 732-748.

Unterhalter, E. (2001). What is Equity in Education? Reflections from the Capability Approach. In W. Hutmacher, D. Cochrane & N. Bottani /Eds.), *In pursuit of equity in education: using international indicators to compare equity policies*. Springer Science & Business Media.