Chapter 1
Disrupting ‘Development’ as the Quality/Equity Discourse: Cyborgs and Subalterns in School Technoscience

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Anita: I used to like mathematics and I was good at geometry. Yet, there is this oxymoron [...]. And, indeed, everybody believed —towards the end of secondary school—that I will become a scientist.

Anita: All these years [...] I have come to realise that mathematics and technology are fields unfamiliar to women.

Anita: No, look, to be more specific the case is different for young children. If they, already, have family support [...], if they have a computer at home, they can work creatively. The issue is access to computer at home. Then, there will be time and space for girls. I believe that the children of tomorrow will show us that certain taboos can be broken.

Anita, 37 years old, female school teacher, Greek
[Gender, Mathematics, Technology Project Data File]

Giorgos: [...] men are more into technology. They like it. Whilst women —those who get involved—because not all of them get involved, they do so, I believe, out of necessity. In other words, men have a passion (for technology), they buy magazines about technology [...] whilst women do not care much.

Giorgos: Look, in my school (engineering dept) ... men might get involved much more with computers, with technology and the like, but, I think that the girls in my school [...] also cover this gap. Because, they handle whatever is required from technology. They do not go beyond it. Only to cover the school demands. Whether they like it or not.

Giorgos, 20 years old, male engineering student, Greek
[Gender, Mathematics, Technology Project Data File]
Afrodite: I feel very repressed in all possible ways in what concerns school [...]. I can manage many challenging things, but I fear [...] something I cannot explain even to myself. I have discovered that I have the abilities to improve my life. And I am not saying this in order to praise myself. At some stage, [...] my family encouraged me [...]. They (people from her family) were saying ‘you make the beginning of a new life’. And this was for me an important point in my life. It made me think of school as the most important thing in the world. It made me think like this until I started coming into contact with completely different things [...]. I then started re-considering how helpful school is since I knew that I would not use it in my future. For I knew that I would repeat my parents’ story. Namely, I will get married, I will raise children, and I will be involved in housekeeping and child caring. In this way, my world was demolished. My whole being was demolished. Why? At this moment, I started taking the words of others seriously, that it is a shame for somebody, especially for a girl, to attend elementary school.

Afrodite, 12 years old, female school student, Gypsy Greek [quoted in Dafermos (2005): 257–259]

Women, Mathematics, Technology and other Dangerous Things

Lakoff (1987) used the catch phrase ‘women, fire, and dangerous things’ as a title of a book concerned with how human thinking is totally immersed in metaphors and depended on their role to produce meaning in everyday talk. His choice to place the word ‘women’ next to ‘fire’ and next to ‘dangerous things’ intended to show the power of metaphor-use in language-use. It, also, served to produce a certain ‘image’ of the possible meanings concerning the category ‘woman’. First, a woman is a thing—not really a person. In addition, a woman, like fire, is a dangerous thing. The semantic categories of ‘mathematics’ and ‘technology’ along with those of ‘women’ and ‘fire’ in Lakoff’s choice of words seem to exemplify, when placed together, a similar ‘dangerous’ liaison, for good reasons, as will be shown in the sections below.

[Mathematics and technology are unfamiliar fields to women] says Anita, a primary school teacher in her late 30s, whilst Giorgos, a young engineering student, argues that although some female students can cope well with what is required to do with technology during coursework, they lack a passion for it. Coping well with school subjects, including mathematics and technology, creates emotional conflicts for Afrodite, an adolescent Greek Gypsy girl, who senses that she will soon need to abandon school for an early marriage—repeating her parents’ story. Education, and specifically mathematics education, provides her with a promise of joining the desired ‘modern’ ways of imagining, organising and controlling her life. Simultaneously, this very desire soon becomes an unfulfilled promise, creating frustration, pain and feelings of failure. Schooling turns out to be an (almost) impossible path for Afrodite, who, despite being a successful learner, wonders what might be the
real value of school for her. Schooling demands a cultural border crossing, and a constant compromise amongst conflicting ‘values’ related either to community or school formalities. Afrodite becomes ‘voiceless’, ‘hopeless’ or a ‘subaltern’ in Spivak’s (1992b) words as her struggle for recognition proves futile or un-ending.

Anita remembers being good at mathematics (geometry), but contrary to her family’s and companions’ belief in her capacities, chooses not to study mathematics since she feels that ‘science’ is not really suitable for her as a woman. Despite her choice not to engage in what was perceived as natural for her, she recognises the fact that the ‘new’ generation has the potential to reverse such stereotypes if, as she argues, access to both resources and expertise is safeguarded. However, Giorgos, a young male who belongs to this ‘new’ generation, seems to espouse that women’s pursuit of science is not out of pure interest or passion but of mere necessity to acquire the skills required in modern society. Lack of passion and ‘pure interest’ show that women’s relation to technology is weak, subordinated and marginal. As such their pursuit of technology is taken as ‘different’ and becomes ‘other’.

Giorgos, like Anita, invests on hegemonic discourses which naturalise young women as non-passionate, non-dedicated participants in techno-scientific practices arguing that they ‘get involved […] out of necessity’. Taking into account the fact that the discourse of an intrinsic ‘passion for science’ is predominant when scientific creativity and innovations are taken into consideration (Turkle 2008), one easily concludes, as Anita does, that ‘women are not really made for the worlds of mathematics and technology’. In contrast, the case of Afrodite shows that passionate desire alone does not seem to safeguard a continuous participation to education (including mathematics education). Afrodite lives at the borders of two competing discourses; the one depicting school as ‘the beginning of a new life’ and the other emphasizing that ‘it is a shame for a girl to attend school’. Schooling represents the risky path towards a ‘new’, yet ‘uncertain’, life. In a similar vein, Anita rejects ‘uncertainty’ and chooses a safer area for study and work.

The narratives offered by Anita, Giorgos and Afrodite are inscribed within discourses that carry a ‘negative’ sense of female experience with technology, mathematics and education. Not only Giorgos, but also Anita and Afrodite seem to be captured within gendered discourses espousing a fixed view of women’s relation to technoscience. Their stories are not interpreted in a positive way, but instead perpetuate the projection of stereotypic images. According to Foucault (1972, p. 49) discourses function constitutively towards producing ‘truths’ which ‘systematically form the object about which they speak’. This approach explains how hegemonic discourses serve to reproduce women as having distinct ways of knowing (Belenky et al. 1986) or that technoscience1 is mainly a masculine route towards realising the rational, modern ‘self’ and developing systemic societal change (Ellul 1964). Within this realm, school mathematics and technology are not seen a ‘female’

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1 According to Wikipedia Technoscience is a concept widely used in the interdisciplinary community of science and technology studies to designate the technological and social context of science. The notion indicates a common recognition that scientific knowledge is not only socially coded and historically situated but sustained and made durable by material (non-human) networks.’ (http://en.wikipedia.org/wiki/Technoscience).
choice since women deal with technomathematics in ‘different’ ways—ways that potentially can work towards ‘disrupting’ commonly held assumptions and expectations. Women’s relation to technoscience can be seen ‘disruptive’ as they embrace technology and mathematics without revealing a devoted passion. Instead, their engagement seems to be a continuous struggle towards fitting technoscientific materialities in the multiplicities of their everyday working, studying and living. Yet, women’s struggling to appropriate technoscientific knowledge is often read as problematic. The issue of ‘woman as a problem’ has been discussed extensively in relation to technology (Wajcman 2007), but also in relation to mathematics (Fennema and Leder 1990). And, its assumed ‘normality’ can be oppressive as it does not allow ‘other’ subjectivities to emerge and does not voice alternative positioning(s).

Following Michel Foucault and Judith Butler, the present chapter attempts to re-read hegemonic discourses of female relation to techno-mathematics. Foucault (1972, p. 151) observes insightfully how discourse ‘obeys that which it hides’ and becomes ‘the path from one contradiction to another’. He argues that ‘to analyse discourse is to hide and reveal contradictions; it is to show the play that they set up within it; it is to manifest how it can express them, embody them, or give them a temporary appearance’. Discourse as contradiction comes close to notions of ‘disruption’ and ‘trouble’ as promoted by Butler (1990, 1997) arguing for the need to deconstruct what are often seen as ‘normal’ or ‘natural’ assumptions on agency, subjectivity and identification. Along these lines, the present chapter aims to move beyond a negative interpretation of women’s relation to technology and mathematics as passive, indifferent or marginal. It argues that female partial and at times marginal positionings could problematise technological determinism (Ellul 1964) and bring forward an alternative reading concerning our understanding of technoscientific practices where the complex incompatibility of using technology and mathematics is not concealed but spoken out and negotiated. It is suggested, here, that an alternative reading might be closely related to disrupting assumed normalities of human-technoscience relation(s) by means of disrupting ‘development’ as the quality/equity discourse in technology-mediated mathematics education.

Such an alternative approach to technoscience then becomes a dangerous gesture to development discourse(s). Danger is encountered at several levels. First, opting out technology and science is ‘dangerous’ for the ‘modern’ individual as it blocks the development of the rational subject and perpetuates the ‘savage’ and emotional self. Second, this very fact becomes dangerous as it holds up the development of modern systemic changes where ‘self’ and ‘society’ is interchangeably linked. Development here entails both a quality direction (i.e. towards becoming the rational subject) and an equity dimension (i.e. all subjects need to become rational or else techno-mathematically literate). However, narratives concerning women’s relation to school technoscience do not profess this very notion of development. Instead, they exemplify a ‘dangerous liaison’ as far as women instrumentally make use of their right to opt out, to resist, or to become marginal actors (see also Chronaki 2008). The vision of an equitable future within mathematics education is, also, critically dependent on the potential of reworking what it means to assume a sense of ‘I’—an agency that is subjectively negotiated. Specifically, women, instead of committing themselves to the ‘risky’ path of a
‘passionate’ experience with formal education and ‘new’ technologies they turn towards a ‘modest’ relationship carefully negotiating boundaries. Haraway (1997, p. 130), considers technoscience as the story of globalisation and argues for the significance of a ‘modest witness’ position as a space for feminist work—a space where technoscientific knowledge is regarded as situated ‘deep and wide throughout the tissues of the planet, including the flesh of our personal bodies’.

This chapter attempts to provide a type of bird-eye view over a very complex area that, at present, pressurises teachers and students towards adopting ‘new’ media, ‘new’ roles and ‘new’ identities. This intensity for change is being discussed under the caveat of development by providing access for all (i.e. equity) via technology-mediated mathematics education curricula. However, what do we really mean by development? And how do these relative links among school technoscience appropriation, development, quality and equity affect the daily lives of women and men and especially of women and men who belong to marginalised, oppressed and voiceless groups? Taking into account the above, the following sections attempt to re-read hegemonic discourses on ‘development’ as ‘quality’ and ‘equity’ in mathematics education with an eye to disrupt assumed positioning(s)—or, in other words, to analyse how discourses can ‘hide and reveal contradiction’ (Foucault 1972, p. 151).

Development as Quality: Intensity for Change

Whilst equity, as Secada (1992, 1995) claims has been marginally explored in the research field of mathematics education, quality has been well emphasised. From the 1980s onwards, mathematics education research has greatly invested on promoting innovative curricula design in order to promote quality teaching and learning. Main sources for theorizing quality have been certain psychological perspectives based primarily on either constructivist or socio-cultural approaches to learning. Curricula innovations included the cognitively guided instructions for mathematics, contexts for authentic learning, realistic mathematics education etc. (Schoenfeld 1994; Greeno and The Middle School Mathematics Through Applications Project Group 1998; Treffers 1987).

Issues of quality were mainly discussed in relation to the micro-context of mathematics classrooms taking into account primarily didactic and pedagogical aspects. Emphasis on how children develop mathematical skills and competences has led towards focusing on cognitive and meta-cognitive strategies as they relate to social interactions (teacher intervention, group work, classroom activity). Despite commonalities, constructivist and socio-cultural perspectives could hardly agree on fundamental principles concerning learner agency and knowledge status. On the one hand, a constructivist perspective2 directs attention to the learner as an active

2 The notion of ‘a constructivist perspective’ is used, here, in an excessive way, but one needs to keep in mind that more than one constructivist perspectives have been formed within the field of (mathematics) education, such as interactive, dialectic, radical, social etc. (Chronaki 1992, 1997).
autonomous subject who potentially reflects on and negotiates ideas by means of experimenting with suitable materials. Learning and knowledge development, thus, depend mainly on explorative activity, reflection and active engagement with task parameters. A mainstream socio-cultural approach, on the other hand, emphasises semiotic mediation, tool-use, and collective engagement with purposefully organised activity. The learner is conceived as a motivated subject who needs to actively interact with more knowledgeable others and to purposefully use tools that bridge the gap among past, present and future historical practices, forming zones of proximal development (Wertsch 1991).

Stressing the urgency for quality at the micro-level is not isolated from the macro-level reform agendas in mathematics education at national and international levels (TIMMS 2007). Certain curricula politics (i.e. prescriptions for content, skills and competences, assessment methods) act as ‘ideological state apparatus’ (Althusser 1971) that regulate behaviour at the micro-level of human interactions. In that way, reform implementation mediates the macro-level societal structuring and creates micro-spaces (e.g. didactic innovations) where self and society develop together. As such, the stress for quality in mathematics education curricula cannot be considered neutral. Mainstream constructivist and socio-cultural perspectives work synergistically towards this end and provide a language for re-producing and legitimizing discourses of ‘quality’. Such discourses materialise by means of curriculum reforms and innovations in schools and classrooms (i.e. mathematical content and competences such as active learning, collaborative work, technology-use, etc.) thus producing fixed identities of the ‘good’ learner and teacher. Walshaw (2001, p. 96) highlights that the learner is seen as constructing ‘...viable theories of the ways in which the world works’, the teacher as facilitating and empowering learners to ‘... give voice to their subjugated knowledge’ and that learner’s personalised and localised knowledge ‘...generate not only visibility but also are said to offer agency in terms of identity and position from which they might act for change’. However, she critiques the view that subject agency can be easily fixed through suitable didactic interventions.

Within this realm, technology-mediated mathematics learning enjoys a prominent position within recent curricula reforms in mathematics education. For example, there is evidence that certain digital tools suitable for dynamic geometry, computer algebra, data handling, statistics, programming and modelling can be instrumentally utilised towards encouraging the development of specific mathematical skills and competences such as visualising, representing and manipulating symbolic entities such as mathematical ideas. At the same time, they foster certain ways of working such as collaboration, reflection, active experimentation, etc. (NCTM 2000; Hershkowitz et al. 2002; Ruthven et al. 2004). Technology-based mathematics education becomes a political arena for teachers, learners and curriculum designers towards producing a particular collective identity change in the name

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3 In a similar vein, one needs to mention diversification across a variety of socio-cultural perspectives ranging the emphasis from psychological to cultural, anthropological and critical approaches to learning and communicating (Kontopodis et al., in press).
of the ‘new’ math teacher who safeguards ‘quality’ learning. Specifically, the ‘new’ maths teacher is required to be a flexible facilitator of knowledge construction, as opposed to knowledge transmitter in the traditional paradigm (Chronaki 2000). Stressing the transformative role of ‘new’ technology is an old issue that reflects broader socio-economic politics in the so-called ‘new’ information age (Castells 1996/2000). The sense of ‘new’ becomes a reference to the most glamorous recent past and implies that ‘new’ equals ‘better’ and thus ‘new’ is associated with quality. The ‘new’ signifies ‘the cutting edge’, the avant-garde, the place for forward-thinking people to perform (and become) designers, producers and practitioners. Thus, discourses of ‘change’ tend to become avenues to ‘new’ and relate to long-lasting modernist views of social progress and development as smoothly delivered by technology (Lister et al. 2003).

Investment on such discourses emphasises the revolutionary impact of technology towards producing profound transformations of maths teachers’ everyday life in terms of evolving techniques, skills, relations, feelings, communicative practices and organisational structures. The transformative impact of ‘new’ technologies has been mainly discussed as far as it concerns epistemological, pedagogic and didactic potential for change through the analysis of focused teaching experiments (Marriott 2002). Despite the benefits outlined in such exemplary cases, and the high investment on time and economic resources, widespread technology integration in mathematics classrooms remains a challenge (Ruthven et al. 2004). In addition, a number of studies indicate how female teachers and students do not choose related fields to study and work and rarely report long-lasting transformative experiences (Wajcman 2007). In a similar vein, Anita, Afrodit and the female engineers position themselves in discourses that inscribe them as ‘different’ when compared to men on the basis of lacking not only passion, but also the flair for active engagement and the competence for deliberative decision making. However, the discourse on ‘difference’ can easily slip into discourses of ‘gender gap’ and ‘female danger’. Although, Anita, Giorgos and Afrodit are different cases in terms of age, gender, race and school role (teacher, undergraduate student and secondary school student), they all seem to support the view that women’s liaison with mathematics and technology is not only uneasy, but it can be a marginalised or a ‘dangerous’ one. How else, could one explain Anita’s choice to withdraw from a successful future in mathematics since she senses that aspects of her everyday life might be in danger, and Afrodit’s conflicting experiences that lead her to consider quitting school? But also, how could one predict where young female engineering students might end up in their careers since they, according to Giorgos, lack a passion for technology and science?

In this realm, female teachers and students easily fall into the stereotypic image of resisting technology. An alternative reading is that some teachers and students do not resist technology itself but the stressful requirements for immediate ‘change’ towards a predefined quality agenda. They realise technology as a risky terrain and they set boundaries on technology use. Illich (1972) has argued that good and evil are not attributes of technology per se, but of technologies-in-use. For example, Anita realises how incompatible is for her to invest on mathematics or technology as a career pursuit. Similarly, female students reject a passionate relation to
technology and concentrate, instead, on more pragmatic approach in specific localities. Whilst, males are believed to be passionately attracted by ‘new’ technology, as Giorgos, the young engineer states, their female counterparts, although competent, do not perform a passionate desire.

Instead of pursuing uncritically a path towards identity ‘change’, our data of women narratives urge us to consider the human-machine relation as situated in everyday practices. This view agrees with feminist perspectives on technoscience that alert for the importance to move away from a view of ‘change’ as development towards a full masculine self-realisation. Specifically, Haraway critiques a number of Marxist and psychoanalytic epistemological positions on feminism and turns to explore the complex production of woman/difference/other in relation to technoscience. Striving for a move away from dichotomies, dualisms or binaries situated in discourses that indicate a ‘lack’ (e.g. lack of passion, interest, competence) and reproduce gendered technological essentialism or technophobia, Donna Haraway introduces the notion of ‘cyborg’ as a metaphor for a hybrid entity that blurs the boundaries between organic and mechanic. The cyborg refers to the ontology of an enhanced command-control-communication-intelligence system (c3i) where human-machine organisms are integrated into a symbiosis that transforms both (Haraway 2004, 2006/2009).

The cyborg, short for cybernetic organism, is taken to be the image of an ‘augmented human’ suitable for extra-terrestrial explorations, scientific experiments and science fiction narratives. But, Donna Haraway uses the term as a prime resource to imagine an alternative kind of material-semiotic world, an alternative perspective of identity politics, and in consequence an alternative optic of feminist technoscience. The notion of cyborg denotes that dichotomies and dualisms such as nature/culture, woman/man, body/mind can no longer be used to figure or create the other. She claims that; ‘[…] Instead, the cyborg is resolutely committed to partiality, irony, intimacy, and perversity. It is oppositional, utopian, and completely without innocence. Cyborgs are not reverent; they do not re-member the cosmos. They are wary of holism, but needy of connection’ (cited in Schneider 2005, p. 64).

This particular ‘cyborg’ point of view allows us to re-consider female relation with technoscience by appreciating its intense partiality. In this sense, Anita’s and female engineers’ experience as non-passionate, partial, disloyal could be considered as a ‘cyborg’ position. They can be seen as ‘augmented’ human creatures as they appropriate, utilise and negotiate varied uses and productions of technology in their

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4 Cyborg, short for cybernetic organism, is a term coined by the research scientists Manfred Clynes and Nathan Kline in the ‘60s as they tried to imagine the kind of augmented man that would be necessary for extra-terrestrial exploration or space flight. It refers most particularly to an imagined and actual mix of machine and organism so as to constitute an integrated information circuit. [...] The first cyborg, from Clynes and Kline’s lab was a white lab-rat with an osmotic pump implanted to allow the researchers to inject chemicals to control and observe aspects of the rat’s physiology. [...] Donna Haraway has taken cyborg as a metaphor to draw together an array of critical questions about human-machine relations and varied embodied forms of technoscience as part of socialist feminism. Recently, the cyborg had emerged as a figure in popular culture and especially in science fiction (Clynes and Kline 1960; Haraway 1991).
everyday lives. Through cyborg a more nuanced and complex angle of vision is offered that sees the technoscientific as a field for the contestation of meaning and the possibility of remoulding and redirecting what looks repressive into something more subversive and even democratic. While fully aware of the fact that the image of the cyborg could be as much about global control and domination, or about pre-emptive strikes and imperialism masked as deterrence or defence, Haraway offers an alternative possibility; ‘[A] cyborg world might be about lived social and bodily realities in which people are not afraid of their joint kinship with animals and machines, not afraid of permanently partial identities and contradictory standpoints. The political struggle is to see from both perspectives at once because each reveals both dominations and possibilities unimaginable from the other vantage point’ (cited in Schneider 2005, p. 72). As such, the cyborg is not only an image or figure, an entity in reality or imagination, but it is also a standpoint, a way of thinking and seeing.

Calling the late twentieth-century understanding of the relationship between organism and machine a ‘border war’, Haraway (1997, 2006/2009) recommends instead a pleasure to be found in bringing about the destabilisation of these boundaries and an accompanying heightened ‘responsibility in their construction’. This means that intensity for ‘change’ via discourses of ‘quality’ cannot be taken for granted as if it constitutes a ‘normal’, ‘neutral’ or ‘static’ path for development. Discourses of quality as identity change towards developing a ‘fixed’ list of goals promotes ‘fixed’ and ‘static’ identities and denies a ‘cyborg’ view on women’s experience with technology. Specifically, it conceals the fact that ‘development’ happens in multiple, complex and hybrid ways where boundaries between humans and machines are disintegrated and destabilised. In the following section, development as equity will be discussed as the urgency for all to change with/in school maths.

**Development as Equity: The Urgency for All to Change**

In the field of mathematics education, gender inequity has been, mainly, explored in two interrelated dimensions using, at large, comparative analysis; first in relation to boys’ and girls’ achievements in specific mathematical curriculum content areas, and second, in relation to male versus female participation in areas of study and work that require mathematical knowledge and competences. As far as achievement in particular curricular areas of mathematics (geometry, algebra, problem solving) is concerned, the quantitative data gathered during the last decade inform us that male-female differences have started not only to disappear but even to reverse, since in some countries (e.g. Iceland and Cuba) we, recently, witness some female advantage (Xin Ma 2008 based on a meta-analysis of regional and international studies on student assessment). A number of meta-analytic review studies concerning the relative interdependence of variables such as gender, class, achievement, attitudes, cognitive and meta-cognitive strategies seem to agree that the gender gap has gradually been eliminated (Hanna 2003; Xin Ma 2008). When the dimension of women’s career paths is considered, recent research outcomes point out that although there
is some considerable increase in the presence of females in areas of study, research and work, their participation in scientific fields still remains unsatisfactory (Jutting et al. 2006). For example, the American Mathematical Society (AMS) reports a slight increase in the representation of women in academic editorial boards. Specifically, they explain that between 1994 and 2003 women representation rate has increased from 9% in 1994 to 16% in 2003.

The situation is far more devastating in countries of the so-called developing world, where women still have limited access to work and education. Dunne and Sayed (2002), for example, explain that, in southern African countries only 5% of all female students enrol in mathematics, computing and engineering. Frantzi (2008) investigating women who enrol in mathematics related higher degrees in Greece observes that whilst before the Second World War women mathematicians were a rare phenomenon and mainly came from the middle or upper classes, during the period 1940–1964, more women enrolled to study mathematics and they came mostly from a lower middle class background. Gender inequity, thus, is not an isolated phenomenon but rather greatly related to class, colonial, racial and cultural constraints experienced by the individual as s/he struggles for access and participation in related practices.

One might observe that although there is noticeable increase in female achievement and participation, the gap between males and females continues to create social inequity. Even though female students are as competent as male and enjoy practising technoscience, they continue not to choose the subject as a main field for study or work. The narrative of Afrodite, a young Gypsy Greek girl, as seen in the introductory vignette, indicates how both gender and race discourses prevent not only her continuous participation in schooling practices thus making her a case at risk, but also constitute her ‘voiceless’. Spivak uses the term ‘subaltern’ to talk about how certain colonial and postcolonial discourses constitute not really the ‘voiceless subject’, but the subject who realises the impossibility of ‘voice’. In exemplary cases of female struggles in imperial India she problematises how the colonial world has always been defined by the West. According to Spivak (1999, 1992a) civilisation, progress and even self-identity itself always eludes the subaltern. In other words, the West is defined by differentiating amongst the ‘present’, ‘past’ and ‘future’ as well as by excluding the other. The colonial world has no such self-identity, at least as the Western viewer perceives it. The cry in Afrodite’s diary-writing, perhaps, denotes exactly this awareness of the impossibility to speak and become heard about non-easily fixed, almost un-resolvable, issues.

Based on Spivak we realise how Afrodite becomes doubly the ‘other’ as a woman and as a gypsy woman and how she realises her fragile and fractured self as

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5 Gramsci has originally coined the term ‘subaltern’ in order to address the economically dispossessed, and today Ranajit Guha reappropriates Gramsci’s term in an effort to locate and re-establish a voice or collective locus of agency in postcolonial India. In her essay “Can the Subaltern Speak?” Spivak acknowledges the importance of understanding the ‘subaltern’ standpoint but also criticises the efforts of certain subaltern studies emphasis towards creating a ‘collective voice’ through westernised mediating practices.
she attempts to cross cultural borders amongst home and school. She struggles to live in-between two worlds that require her to continuously cope with conflicting choices and feels emotionally devastated as her diary-writing reveals (Dafermos 2005, p. 257–259). Anzaldua (1987) argues that crossing ‘borders’ is not a simple but instead a process of learning to accept transformations and learning to tolerate contradictions and ambiguities—a ‘mestiza’ rhetoric in her words. Mendick (2005) refers to Anelia, a young Turkish Cypriot girl from a UK-based immigrant family, who also experiences the home/school divide. Anelia, as Afrodite, has a passion for (mathematics) education, but she also perceives that making the choice to study could be incompatible for her life because she holds that ‘mathematics’ is not suitable for a woman. Participation in formal educational practices means for Anelia, as well as for Afrodite, engaging in identity-work that creates multiple contradictions in her life and leads her towards limiting the study of science or considering quitting school (see the case of Afrodite). While both women cope well with formal educational activities—including mathematics and technology—they risk being characterised as ‘savage’, primitive or other. Although this view is highly criticised by contemporary anthropological thinking for being an imposed ‘gaze’ at non-Western cultures (Appadurai 1996; Harding 1998, 2008), such differentiation serves to reinforce the epistemic chasm between savage and rational mind by perpetuating knowledge hierarchies. In addition, this chasm shows, as Spivak (1992b) argues, a concern for the processes whereby postcolonial studies rehearse neo-colonial imperatives of political domination, economic exploitation and cultural erasure—an issue referred to by Spivak as ‘epistemic violence’. It can be claimed that this is due to the fact that ‘development’ for Afrodite and Anelia is counted on an imperialist conception of the world and of technoscience. Spivak’s post-colonial critique addresses the western, male, privileged, academic, institutionalised discourses which classify the ‘other’ in the same measures used by colonial dominance that, ironically, seek to dismantle.

Most Gypsy girls do not perform as individual ‘entrepreneurs of self’, using Paul Du Gay’s words, as their decisions in life are depended on extended family and community values, needs or habits (Du Gay 1996). Living between two cultures, Afrodite has to confront conflicting discourses about either ‘attachment to community life’ or ‘pressure to lead a modern life’ (Chronaki 2009). For her, it is not an either/or situation but instead a desire to be both and this very fact places her in a painful situation. Afrodite’s dilemma whether to quit school or not is connected with pathologising her as incapable of making a sensible choice and as destined to remain subaltern. How could we, then, reconsider ‘equity’ in view of Afrodite? This means that gender equity cannot be simply viewed in terms of comparative studies of male’s and females’ skills and attitudes rooted in quantitative analysis or positivistic interpretations. Afrodite’s urgency to develop is also linked to her urgency to move towards a certain quality of modern ‘life’ inscribed through masculine and imperialist agendas of development. Her case, in particular, urges us to consider this ‘move’ as an unfulfilled promise or as potentially unending.

A major consequence of hegemonic discourses of equity is the constitution of subjects as marginalised, oppressed or voiceless. In an almost pessimistic tone Spi-
vak concludes that the ‘subaltern’ cannot speak in the context of cultural imperialisms and moreover the ‘subaltern’ cannot be given a voice via a mediator. She specifically suggests that any attempt from the outside to grant subalterns a ‘collective voice’ is problematic as first, it assumes cultural solidarity among members of a heterogeneous group of people, and secondly it depends upon western intellectuals to ‘speak for’ their condition. Spivak argues that through such a process the subalterns, in fact, re-inscribe their marginalised and subordinate positions. Afrodite seems to fall into this category. As a gypsy woman she is required to perform a ‘normal’ gendered positioning as constructed by her community. Taking into account that ‘normal’ is a fictional category one can claim that there is no normal way for any gender to act. Gayatri Chakravorty Spivak optimistically argues that although we cannot ‘give’ a voice, we can clear the space for the subaltern to speak. She suggests that instead of urging for a ‘collective voice’ by means of the Western logos, it is preferable to focus on clearing the subalterns’ path so that their voice can be heard. The subaltern, be it a Gypsy adolescent girl or a Western woman who, though competent with computers and maths, chooses not to make them a priority in life, seems to live at the margins of hegemonic discourses of ‘development’. Clearing the path for them to be heard, in the context of this study, is closely related to troubling and disrupting—in Butler’s words—‘development’ within hegemonic discourses by revealing contradictions and taking seriously the contextual processes that constitute marginalised and voiceless positioning(s). Growth, progress, development all seem to safeguard quality. And access to quality for all is assumed to be the measure for equity. Quality and equity, thus, become the two opposite sides of the same coin called ‘development’.

**Conclusionary Remarks**

Technoscientific practices, and school technoscience in particular, are central to both self and society ‘development’. A recent anthropological study shows how ‘namba tok’ (number talk or the use of statistics by colonial officials) is coupled with ‘kaantri’ (country) creation in the consciousness of the Nimakot people of central New Guinea who see their lives changing from nomadic to settled inhabitancy (Wesch 2007). What we have come to call ‘modern’ society has emerged through production and appropriation of a variety of ‘technologies’ including arithmetic, archiving and spacing structural systems utilised to organise and control daily mind-body practices. Dunne (2008), based on Foucault (1977/1980, 1991) discusses the political role of mathematics and technology as core values of modernity and explains how both are utilised to define and fulfil goals of ‘development’. This happens simultaneously at two levels; first, they are used to measure the achievement of certain predicted economic, social and educational outcomes, through a broad application of statistics, and secondly, by applying pressure, via local and national educational policies, mathematical and technological literacy is promoted. An imperialist (and sometimes a post-colonial) agenda of governmentality means that
women’s access to and participation in these subject areas are measured and evaluated against that of men and western culture. In other words, the dominant discourse of development serves to legitimise ‘women’ as ‘others’ (i.e. women, as primitives, need to develop and progress).

From this point of view, technology-mediated mathematics education is not merely a tool for better understanding mathematical concepts, but can be seen as a tool for introducing learners to certain standards of ‘modern’ life—and for some (including women) this can be a risky, unsafe and uncertain terrain. Hegeemonic discourses, based mainly on constructivist and socio-cultural agendas, tend to overemphasise the ‘active’, ‘rational’, ‘autonomous’ learner who is able to instrumentally utilise any accessible technology and make timely choices and decisions. However, such a view eschews the ideological underpinnings of an oversimplified adherence to modernist and neoliberal ideologies. Walkerdine (1993) and Rose (1999), amongst others, explain that discourses related to an impetus to govern modern life are based on the virtue of self-reliance (autonomy, self-regulation, self-efficacy, etc.) and reflect mainstream and conservative psychology or sociology. Rose (1999), in particular, supports that the burden of ‘choice’ conceals the broader social context in which jobs for life have disappeared leaving the fiction of life-long learning instead. Simultaneously, inability to choose, to act or to make appropriate decisions signifies inability to perform as an ‘autonomous subject’ which then results into lack of development and leads to marginalisation.

As explained above, self/society development requires both a quality and equity dimension. Within the confines of imperialist, colonial and patriarchal discourses, development is taken to be equivalent to the construction of a fixed ‘rationality’ as the ultimate goal for quality. Rational development is also taken to be at the heart of technoscientific practices including mathematics and technology-related literacies. Therefore, quality in mathematics education curricula and practices is taken to be a cornerstone for safeguarding quality/equity and minimising exclusion and marginalisation.

However, women often seem to either resist or embrace partially and without passion certain technoscientific practices affecting their daily life or work. Such a standpoint can be stereotypically interpreted through the ‘woman as a problem’ optic—an interpretation rooted in hegemonic discourses of quality/equity. As previously seen, on the one hand, some mainstream constructivist and mainstream socio-cultural perspectives strive to prescribe quality in mathematics education, and on the other hand, certain mainstream feminist perspectives focus on investigating gender inequity not only at the level of achievement, competences and attitudes but also at the level of access to and participation in mathematics and technology-related fields. While constructivist and socio-cultural theorists emphasise quality curricula, feminists identify gender gaps. In simplified terms, it may seem that one’s work serves (to sustain) the work of the other. In other words, when a gender gap becomes identified, a quality curriculum will be there to fill the gap. But life is not that easy.

In the realm of the present chapter, it has been argued that hegemonic discourses of quality/equity as means for self/society development need to be approached...
through alternative perspectives that enable subjects to move beyond a pressurising emphasis to a singular ‘perfectionist’ relation to technoscience. Hegemonic discourses tend to read women as ‘others’ by their being considered, perhaps unintentionally, as the passionless and subordinate users of technoscience. By re-reading these stories we come to realise, that involvement in mathematics and technology in school practices is *neither* simply a matter of access to equitable sharing of resources, knowledge and support *nor* an issue of a particularly passionate interest and positive attitude towards the subject. Women and men seem to live in complex localities that require them to simultaneously appropriate not one but a number of discourses that often become competing forces in both personal and school lives. The notion of ‘cyborg’ induces a renewed vision of quality, as far as the subject’s involvement in technoscience is concerned, emphasising partiality and hybridity. Women as ‘cyborgs’ can be fragile and fractured amalgams of a human-machine organism and can claim for themselves the right to ‘error’, to express ‘failure’, to demand ‘connectivity’ and to feel confident with ‘partiality’. According to Haraway (2006/2009), it is not the ‘machine’ that women reject but the insecurity that comes as a result of communication breakdown. In other words, it is the fact that they do not seem to have control over the fluid relation which develops between humans and machines that requires a ‘holistic’ instead of a ‘connectivist’ relation to technology. The cyborg metaphor, thus, has the potential to become a way of thinking and re-working subjectivity as situated, hybrid and partial.

In addition, the notion of ‘subaltern’, as argued by Gayatri Chakravorty Spivak, offers an alternative optic on issues of difference or otherness as they affect marginalised, oppressed and voiceless subjectivities. She claims that by having limited access to cultural imperialism and by being constructed as ‘different’ or ‘other’, the subaltern can signify the ‘proletarian’ whose voice can not be heard as it is structurally deleted from the capitalist bourgeois narrative. Furthermore, she objects to the view that since the subaltern cannot speak, an advocate is required to speak for her, arguing: *Who the hell wants to protect subalternity? Only extremely reactionary, dubious anthropologic museumizers. No activist wants to keep the subaltern in the space of difference [...] You don’t give the subaltern voice. You work for the bloody subaltern, you work against subalternity* (Spivak 1992a, p. 46). The burden created by the organisation of ‘collective’ or ‘mediated’ voices for subalterns constitutes, according to Spivak, a rehearsal of a political domination of ‘voice’ via neo-colonial exploitation that ultimately exacerbates ‘epistemic violence’. Instead, she voices the need to seriously consider clearing the way for the subaltern to speak.

As it has already been shown, clearing the way is a process of disrupting the hegemonic discourses of development that either implicitly or explicitly nurture subalternity. While Haraway promotes a notion of the cyborg that opens up subjectivity to embrace situatedness, hybridity and partiality, Spivak enters the complexities of marginalised and voiceless subjectivity by encountering the subaltern’s voice. The impossible task of being heard signifies the impossibility of realising self as part of society or else the impossibility of belonging. Spivak does not hesitate to criticise the postcolonial practices that assume a ‘voice’ can be given via the mediation of an advocate and passionately argues that the subaltern do not need to be given a ‘voice’
but instead we need to clear the way for them to walk and be heard. This important gesture means that the responsibility of their having a ‘voice’ is simultaneously our responsibility of listening to their voices—a deeply dialogical gesture. As a final word, I would like to argue for the need to consider involvement in school technoscience as a risky gendered territory where subjects negotiate their positions by taking the boundaries and affordances of their localities into account. A situated notion of agency with/in technoscientific practices rejects the utopian and imperialist politics of ‘holism’, ‘advocacy’, ‘perfectionism’ and, instead, pursues ‘connectivism’ and ‘partiality’. For this reason, a turn towards post-structural and postcolonial theorising of female experiences with school technoscience may prove most valuable.

References


