Chapter 10
The Development of Environmental Sustainability Education Within Greenland's Higher Education

Gisele M. Arruda

1 Introduction

The end of the Cold War has triggered a new development trajectory for the Arctic region. This has become less militarized and emerged as a new open space for entrepreneurship and economic development; a process stimulated by political support for industrialization based on the abundance of local commodities and their attractive prices. These factors triggered a still not completely regulated expansion of industrial and maritime activities in the region.

The Arctic is the new frontier, a developing region in need of emergent and expanded understanding about its different complexities and dynamics. It has become an extreme case study for climate change, socio-environmental adaptation and education. The search for natural and energy resources, the dynamism of entrepreneurship, new maritime routes for international trade and new extractive industrial activities in unexplored areas are drivers triggering significant societal and developmental transformation. The challenge for education in this region is to understand these drivers of change and respond appropriately to them.

This chapter is the outcome of 5 years of fieldwork in Greenland, which involved visiting urban and remote communities. The aim was to understand the Greenlandic development process and its drivers of change, not least in the face of climate change impacts, and how this dynamic is addressed by Greenland's Higher Education system. The key questions are to what extent is sustainability present in Greenlandic Higher Education governance and curriculum and how this system relates to its contexts – the changes caused by climate change, modernity, autonomy, education and self-determination.

The development of the Greenlandic education system took place in two distinct historical phases: pre- and post-colonization. Before colonization, education was an

G. M. Arruda (✉)
Global Energy and Sustainability Programme, Coventry University, Coventry, UK
e-mail: garruda@anvivo.org

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informal social activity based on traditional cultural practices, gender-oriented activities with foundations on livelihood and traditional economy and systems (hunting, fishing, crafts, etc) (Aslaksen et al. 2009). After colonization, however, there was a rapid transition from a subsistence-based (hunting and fishing) society with no formal educational system to a complex modern society with new economic, industrial and educational demands.

The structural transformation of Greenlandic society has always involved important occupational and gender transitions leading to economic and educational adaptations. The 1970s were years of intense educational adaptation and prioritization with the semi-autonomous administrative institutions and frameworks introduced by the Danish government. Since the introduction of the Home Rule, primary, secondary and higher education has undergone profound changes in terms of learning goals, language and curricula always oriented by these industrial, occupational and gender transitions. There has always been a concern to promote compatibility from a Greenlandic perspective between the education system (content and frameworks) and the needs of a modern and globalized society. Despite many challenges and setbacks, the goal of the Home Rule government has remained to raise Greenland's education to Nordic levels (Greenland Home Rule 2000). However, there was no reference to Earth systems, climate change, Sustainable Development or Education for Sustainable Development in the mainstream Greenlandic HE curriculum until 2015. Monitoring programmes and scientific data had long been carried out by Nordic scientists. However, after 2015, expertise clusters (expert institutes at the University of Greenland) started to coordinate studies and applied this learning into teaching and learning in a more systematic way. In 2019, the Greenlandic HE system, while continues to be under a transition process, it has already incorporated important sustainability components in order to address historical drivers of change that are transforming Greenland's bio-geo-physical, economic and socio-environmental contexts.

This research considers the methodological challenges of assessing the diverse responses of the Greenlandic population to socio-environmental change, especially given differences in these changes in different areas. Initially, a comparative study of the climatic and socio-environmental impacts was constructed from the formal published literature combined with the grey-literature of regional reports, international conference discussions and 'scientific petit comité'. Insights from this were analysed through interviews with scholars, politicians and local Higher Education authorities' representatives from the Greenlandic government. These data helped create a platform of ideas about the impacts of development on Greenlandic society and how this society creates systematic and contextual knowledge and response to the different drivers of change.

2 First Driver of Change: Climate Change – The Complexity of Contextual Scientific Knowledge and Assessment of Greenlandic Cryosphere (Greenland Ice Sheet Decline)

Greenland, as the largest island in the world covered by inland ice, has a key role in determining the climate in the Northern Hemisphere. Its geographical features and the presence of important glaciers like Kangerlussuaq Glacier (the largest glacier on the east coast of the Greenland ice sheet) and Jakobshavn Glacier (located in the west coast near the Greenlandic town of Ilulissat) make it a perfect location for monitoring patterns of change in the cryosphere and ice sheet. Greenland's position in the North Atlantic, within an ice-filled ocean, its elevation, and the sea currents from the Arctic Ocean create specific climatic dynamics for the island and the surroundings which have been monitored in land by meteorological ice stations and via satellite remote sensing. Programmes like Copernico, CryoSat-2, GRACE-FO, EOS AM-1 satellite, operated by NASA, with the MODIS and ASTER sensors are fundamental to understand changing process on regional and global scales (PROMICE 2019). These tools assist researchers in their interpretation and analysis of the scale of glacier velocities, glacier retreat, ice sheet loss and broader climate change programmes. Due to this technology, it was shown that Greenland's fastest glacier is the Jakobshavn Glacier, which drains approximately 6.5% of the Greenland Ice Sheet (Fig. 10.1) (Joughin et al. 2004; Fausto et al. 2016). However, despite these modern technological tools for investigation, data collection and interpretation of the mechanisms that trigger ice loss, the mass balance fluctuations of the Greenlandic Ice Sheet are still insufficiently understood, although the trend indicates the acceleration of ice sheet decline. Ice sheet and glacier behaviour in Greenland is a sensitive indicator of climate change and it is specially significant to infer quantitative patterns of change in other domains like global temperature, jet-stream, rising sea levels and declines in global fresh water (Oltmanns et al. 2018).

Decline in the Greenlandic Ice Sheet has been studied intensively since 1840. Figure 10.2 displays the current pattern and compares the ice sheet's surface gains and losses in the period 1981–2010 with those recorded in September 2018 until 23rd February 2019 (Box et al. 2009; Mankoff et al. 2018). This estimate follows the Regional Climate Model HIRHAM5 (Langen et al. 2017) and does not include the mass lost when glaciers calve off icebergs and melt as they encounter warm seawater (Bevan et al. 2019).

These patterns observed in the glaciers velocity, the accumulation zone of the Greenland Ice Sheet and the fluctuation of the surface mass balance describe live and dynamic natural systems and represent important sources of climate change data to be interpreted by the international academic community. This kind of research as well as its implications for climate change has been conducted, primarily, by foreign Earth Systems and environmental scientists from Europe and US. However, the information also has great significance for local academic investigators who aspire to orient local responses to this important driver of change and understand its impacts on other local systems (Fig. 10.3).

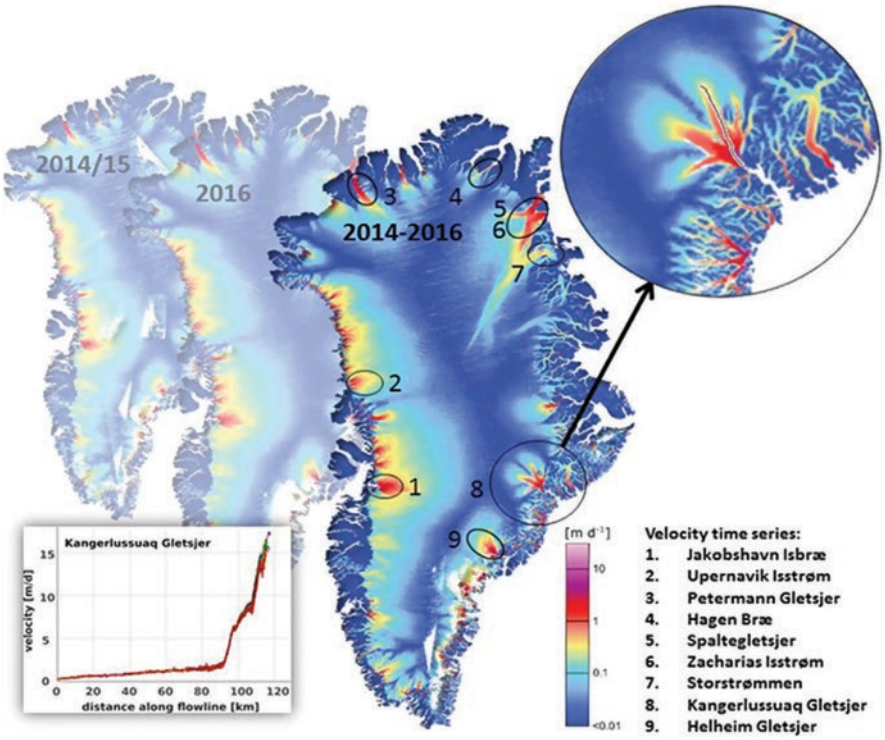

Fig. 10.1 Greenland Ice-cap Velocity time series. Source: ESA CCI (2019)

The cryosphere is an element of the Earth System consisting of water in its seasonally and perennially frozen state (Hovelsrud et al. 2011, p. 2). Its components include snow, solid precipitation, permafrost areas, river and lake ice, glaciers and ice caps, the Greenland Ice Sheet and sea ice (Cogley et al. 2011; Cuffey and Paterson 2010). These cryospheric components form a unique Greenlandic system that is intrinsically interconnected with the ecosystems, social systems and global climate. Changes affecting the Arctic cryosphere alter, significantly, the functioning of local, regional and global socio-environmental and economic systems. Hence, in the last 5 years, Greenlandic Higher Education has started to develop programmes of study and research and to produce scientists with expertise in climate change, Earth sciences, and the human dimension of change. This sets high importance on developing a transdisciplinary HE curriculum that comprehends the bio-geo-physical, economic and socio-environmental interconnections and that informs local communities.

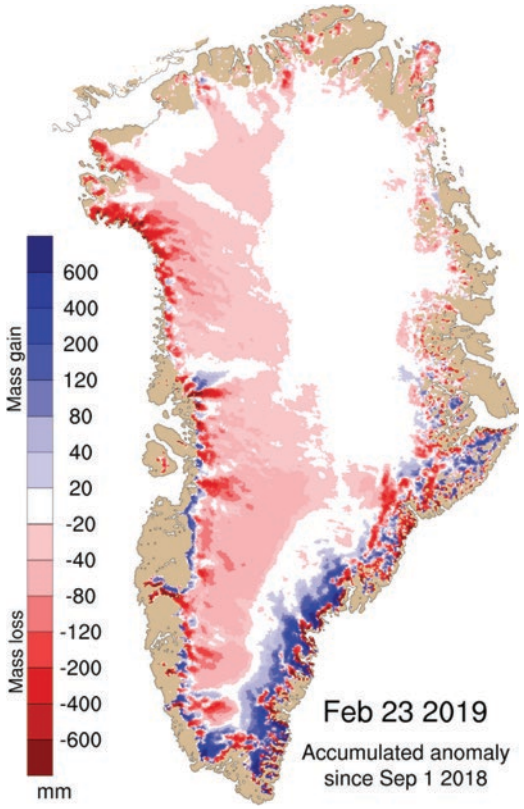

Fig. 10.2 Accumulated anomaly of Greenland's Ice Sheet mass loss according to Regional Climate Model HIRHAM5. (Langen et al. 2017)
Source: http://polarportal.dk/en/greenland/surface-conditions/

3 Second Driver of Change: Greenlandic Context of Modernization

The Second World War was a major turning point in modern Arctic history, not least because of the separation of Greenland, Iceland and Faroe Islands from Denmark. It was also marked by so-called 'friendly invasions' of allied forces, especially in Greenland, which hosted an American strategic air base in the early years of the war, whose powerful indirect influence instigated nationalist sentiments as well as a new national consciousness. This period marks the beginning of 'Home Rule' (Direktoratet for Kultur, Uddannelse, Forskning og Kirke 2004) implying local decisions on cultural, social, health, environmental and economic issues, but, tacitly, the continuation of the dominance exerted by Denmark. Indeed, from the 1721 colonization of Greenland by the Denmark-Norway coalition to the 1950s trading activities of Copenhagen's Royal Greenland Trading Company, ideas from the outside world have driven profound societal change in indigenous Eskimo culture, social order and institutions. According to Jennes (1968, p. 47):

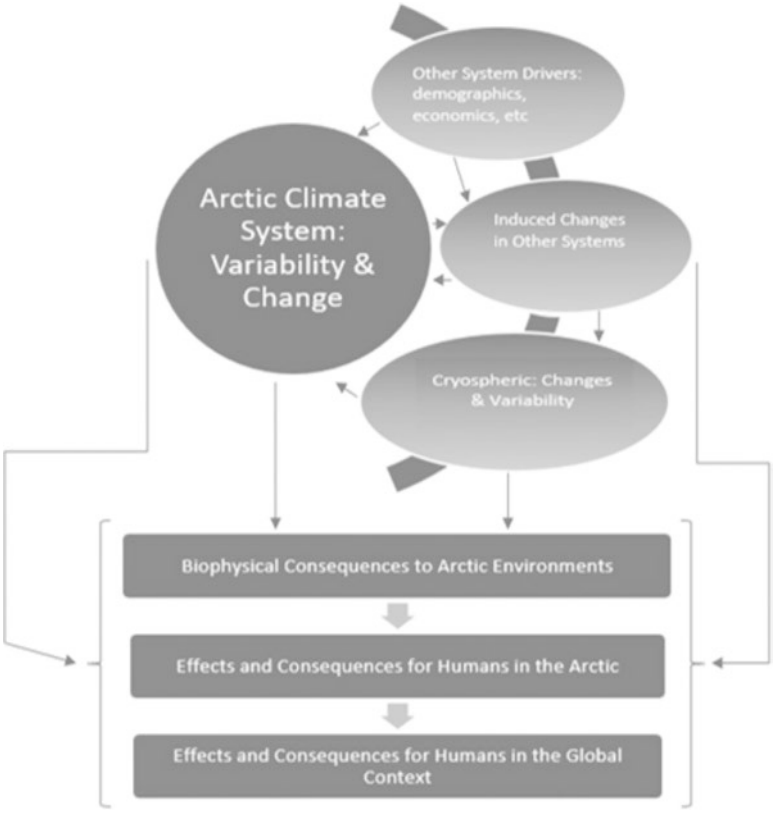

Fig. 10.3 The Arctic cryosphere and linkages to various levels of effects or consequences of changes. *Source:* Hovelsrud et al. (2011)

> in no other region of the Arctic have Europeans deliberately trained Eskimos to lead their people up civilization's steep path [...] only in Greenland have the educational authorities [...] deliberately trained Eskimos and their descendants to lead their people; only there the Eskimo population has been successfully integrated into today's world; a world of modernity, democratic reforms, and a new entrepreneurial spirit offering all the nice goods, which the rest of the world had been using for more than 200 years.

These developments have also created most of the social problems that currently afflict modern Greenlandic society. Greenland is a post-colonial society that has undergone a very rapid modernization process. This has brought benefits that include advances in infrastructure, health care, education and welfare at the cost of the dis-benefits typical of such accelerated development: alienation, urbanisation, and capitalisation (Lee and Newby 1983).

This situation has two particularly important aspects: its impact of development on Greenlandic society and the ways this society has responded to change. Equally fundamental is understanding how these responses align to sustainability principles and how these responses enable adaptation and social equality. Greenland's recent

history raises several ethical dilemmas. Modernity contains an intrinsic paradox of creation and destruction, especially of traditional cultural frameworks, which can present societies with serious dilemmas and, sometimes, an existential crisis. It may bring on board powerful technologies to promote well-being but, at the same time, it can provoke profound crises of reality, truth and identity in multi-cultural societies (Arruda 2018b, p. 107).

Most of the economic activities being developed in Greenlandic communities show the traditional pattern of male-dominance. Industries like hydrocarbon (oil and gas) exploitation, mining and infrastructure generate (currently) 77% of male employment opportunities and thereby reallocate, to the new economic hubs, a great parcel of the social capital previously dedicated to traditional activities (Kleist et al. 2015; Government of Greenland 2009). On the other hand in Higher Education, since 1990, the number of women has exceeded the number of men completing a degree and those who have studied beyond the level of a baccalaureate. Courses like journalism, social work, teachers' training and nursing are dominated by women while vocational education and training are still dominated by men (Poppel and Chemnitz 2009). This context has created severe imbalance in terms of traditional family structure, gender and occupational roles and the proportion of higher educated citizens.

In recent years, the discovery of vast energy and mineral resources in previously inaccessible iced-covered areas of Greenland have sparked much debate about the risks and benefits of extractive industry. Local communities in these resource-rich areas are increasingly exposed to the external pressures of development advocated by governments and their industry partners. Modern infrastructural development is part and parcel of the developments that facilitate resource exploitation. New ports and new maritime routes across the Arctic Sea are being made possible by the decline in sea-ice. However, even in the more developed urban centres of Greenland, there is growing concern about the real costs of becoming an extractive mining economy and recognition that this requires a balanced rethinking of sustainability issues, including their economic, environmental and socio-cultural pillars (Elkington 1994).

Despite the strategic environmental and social risk assessments (SEA/EIA and SSIAs) prepared by energy and mining companies towards gaining licenses to exploit resource-rich areas (Arruda and Krutkowski 2016, 2017) and, despite the specific regulations regarding transboundary pollution and environmental toxicity according to the best international standards and practices (NORSOK – Norwegian safety Regulations; Environmental Benefit Analysis) (NORSOK 2010), there is no systematic Greenlandic sustainability policy in place to guide industries or planners. Companies apply their own strategies of environmental management and infrastructure development and civil society works to promote greater understanding of the impacts of large-scale resource projects through research, information sharing and public consultation but not framed by a comprehensive and systematic governmental sustainability policy. Companies apply their own strategies of environmental management and infrastructure development, while, in the absence of a comprehensive and systematic governmental sustainability policy, civil society is

left to promote greater understanding of the impacts of these large-scale resource projects through research, information sharing and public consultation. Inevitably, this is more than civil society is capable of mitigating and this is reflected in the practical socio-environmental consequences for Greenlandic society. Of course, ideally the Greenlandic government in partnership with its main trading nations (Denmark, EU, US, China), who aim to benefit from exploiting Greenland's natural resources, should work together to ensure the delivery of the United Nation's framework of Sustainable Development Goals (SDGs) (United Nations General Assembly 2015). However, it is not clear that this is happening effectively.

In theory, Sustainable Development means human development. It involves the adoption of appropriate standards oriented to those local values that play a fundamental role in the process of promoting well-being in the community (Larsen and Fondahl 2015; Poppel 2006, 2015). Often, the Western concept of development seems to conflict with local lifeways. Greenlandic communities do not recognise their portrayal through the non-native lens that is applied to them, despite the lip-service to inclusivity of the enterprises (OECD 2011) promoting new technology, the trading of manufactured goods and infrastructural projects. Today's Greenlandic development is conflicted by competing values and cultures. The result is a process that is leading in the opposite direction to freedom of choice and Sustainable Development, at least in the terms defined by the World Commission on Environment and Development (WCED 1987). This can be evidenced by Figs. 10.4, 10.5 and 10.6, which illustrate the absence of a systematic sustainability policy, infrastructure and of a sustainable mindset towards the environment.

Sustainable Development has an interdependent relationship with human development, and it is promoted through the adoption of appropriate standards oriented to values that play a fundamental role in the processes of deliberating on well-being (Larsen and Fondahl 2015; Poppel 2015). Currently, Greenland's development is focused on the life cycle of extractive projects. It is not oriented towards a systematic, holistic and diversified model of development framed by the UN's Sustainable Development Goals (SDGs). However, there may be signs of positive change.

Fig. 10.4 Ilulissat town centre. (Picture: Gisele M. Arruda)

Fig. 10.5 Ilulissat town centre and the market area. (Picture: Gisele M. Arruda)

Fig. 10.6 Ilulissat town centre. (Picture: Gisele M. Arruda)

Recently, Greenland has undertaken an innovative approach to reduce its reliance on electricity produced by diesel fuel by developing the Ilulissat Hydroelectric Project. This is a mega hydropower project driven by glacial meltwater and the discharge from natural glacial lakes. Here, meltwater is channelled 200 m through the permafrost to underground turbines in a sea-level powerhouse (Arruda 2018).

4 Third Driver of Change: Greenland's Autonomy and Education

In international law, Greenland is a self-governing Arctic country (United Nations General Assembly Resolution 1962), which nevertheless remains, formally, part of the Kingdom of Denmark. Greenland's education remains intrinsically linked to the Danish educational system despite Greenland having taken responsibility for its own educational governance since the 1980s under the Home Rule system (Gulløv 1979). The mantra of Greenlandic local policy is 'autonomy' and 'independency', a mind-set revealed by several interview reports. Greenland, seeing itself as a post-colonial nation since the 2009 Self-Rule Act (Government of Greenland 2009), is actively seeking control of its development opportunities and its right to manage natural resources. These issues are clearly reflected in Greenland's Higher Education system. Interviewees are under code names to ensure confidentiality as per Table 10.1.

Much is inherited from Greenland's colonial history and a colonial system based on ethnic and social stratification (Sørensen 2006). Some is the product of Christian missionary works, which supported education 'and protection' by the 'mother land' (Marquardt 2010). This social stratification created inequality (Greenland Home Rule 2003), which still persists, as Danish people dominate the government as high income civil servants with mixed-blood Greenlanders in lower status, lower income appointments.

With increasing autonomy and independence, new educational policies and higher standards of local education were required to enhance the number of graduates produced by Greenlandic Higher Education. The European Commission (2013) recommended that output needed to reach 100 graduates per year to avoid a potential shortfall of 2000 graduates by 2025 (EU Commission 2013; Fig. 10.7). This

Table 10.1 Interviewees and quotes

Interviewees	Quotes
Dina (Inerisaavik – Pedagogical support staff)	'The curriculum was designed in the 1970s and it has been reviewed since then' (…) the curriculum has no evident links with environmental sciences. It has been a long period of reform but since May 2015 significant changes started to happen and I need to figure out the basis, motivation and outcomes of it.'
Patrik (education Ministry's advisor)	'The official report from the Greenland's Ministry of Education, church, culture and gender equality (the education plan II) created reaction in relation to the whole educational systems in terms of leadership, teaching and parenting.'
Birgit (higher education expert in pedagogies and curriculum)	'Environmental sciences are part only of the curriculum for children and youth but not part of the higher education curriculum yet.'
Erna (educator)	'The reform also focuses on the Personal Development Plan (PDP) to tackle social, psychological and internationalization issues.'

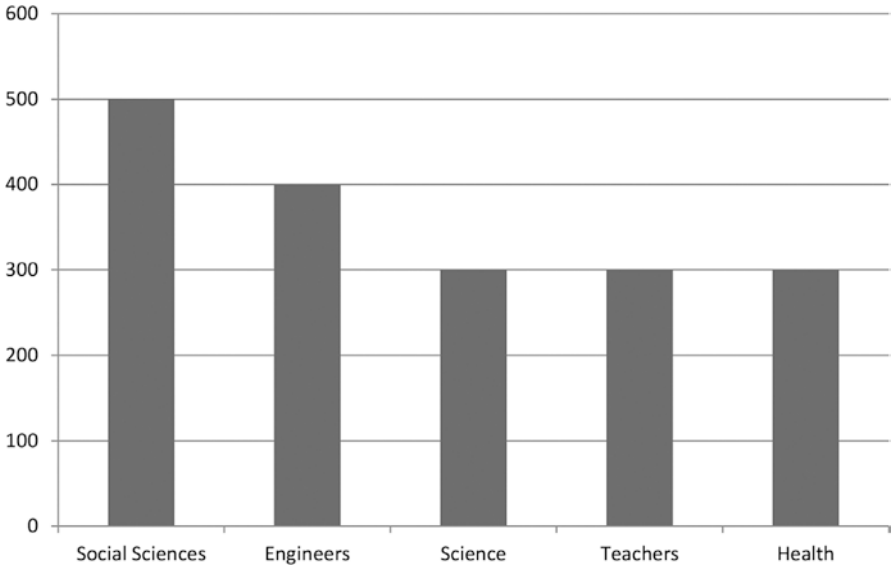

Fig. 10.7 Expected shortage of graduates in 2015 for the main domains of Higher Education. (Adapted from EU Commission 2013)

challenge continues and there is a lack of professionals in almost all subject domains (Elmore 2006; Danish Agency for Higher Education 2014). The problem is compounded by low application rates from students graduating from secondary education, who do not feel it worthwhile to continue their studies. Part of the problem is that, in practice, students entering Higher Education still need to be proficient in both Danish and English.

The contradictions generated by the intermingling of Greenlandic and Danish cultures make it possible to argue that 'modern Greenland is understood as being "Danish" rather than "Greenlandic" because 'Greenlandicness' (Thomsen 1998) often refers to 'old' traditions of hunting, fishing, story-telling, etc., while modernity is considered "Danish" (Brincker 2017; Thomsen 1996). In words of Bjørst (2008, p. 29) 'it may seem difficult to be both Greenlandic and modern' at the same time. This dichotomy is the source of a major mismatch in Greenland's Higher Education with effects on other areas of people's lives because for a young person living in Greenland there is a huge distance between the everyday life at an education institution and his or her family life of ancestral routes. The traditional and the modern, living side by side, an educational mismatch with several social implications.

The sense of autonomy and self-determination also accelerated educational policy making and intensified the need for educational outcomes to address the expected shortage of graduates. This has created an extra layer of pressure on matters relating to identity, autonomy and self-determination. Local documents, interview reports and local literature all argue that the curriculum of the whole education system in Greenland is a product of the 1970s. Subsequently, the curriculum is being subject

to government review in an attempt to build capacity and support national educational updating and achieve reform that is sensitive to Greenland's geographical complexities, where most settlements are very small, isolated, and very different to towns like the capital Nuuk, whose population of circa: 17.984 represents almost a third of Greenland's total (City Population 2019).

Greenland's first significant curriculum reforms began in 2002 and developed continuously until the present (Wyatt 2012). The main concern has been to close the cultural gap in an educational system that contributes to young students' reluctance to enter Higher Education. This challenge calls attention to the importance of cultural compatibility in indigenous education (Demmert and Towner 2003; Rivera and Tharp 2006) and it was the base for a nation-wide reform aimed at creating culturally compatible education. This work was based on the Standards for Effective Pedagogy developed at the Center for Research on Education, Diversity, and Excellence in Hawaii (CREDE 2019). The CREDE standards (Table 10.2) represent principles of effective teaching and learning derived from studies conducted in other indigenous communities that aim to promote 'cultural congruity' (Wyatt 2010). These have been applied to help enhance the linguistic abilities of Greenlandic students' and support their native cultural identity with the purpose of improving their employability and Greenland's labour market.

In recent decades, most educational initiatives have been funded by the EU and by Denmark due to its close relationship with Greenland, which provided the necessary funding for reform, but, later, this relationship was reviewed, renegotiated and the level of support reduced. With less available funding and in the face of economic instability, inflation, and an ageing population, many people started seeing the new energy and mineral developments as a unique opportunity to be independent from Denmark and stabilize the local economy.

The year 2015 became a second landmark date for educational reform in Greenland and educational development became a political priority, according to the Ministry of Education secretariat. The Ministry of Education focused its new strategy on the integration of curriculum of the whole educational system, not only Higher Education but also, on preschool, primary and secondary, high-school, education targeting children's and youth education, in part, to increase progression to Higher Education. The belief remains that investing in the culturally compatible education of children and youth will increase entry to Higher Education (Wyatt

Table 10.2 CREDE Standards for teaching to promote cultural congruity

(a) Joint productive activity	Teachers and students collaborating on joint products
(b) Language and literacy development	Teachers supporting language development in all classrooms and subjects
(c) Contextualization	Teachers making connections between students' prior knowledge and new information
(d) Complex thinking	Teachers supporting students' engagement and skills in critical thinking
(e) Instructional conversation	Teachers instructing through dialogue

Adapted from CREDE (2019)

2009; Kahlig and Banerjee 2007). However, progress continues to be constrained by inefficient implementation.

One key focus is language learning. Just 10% of the Greenlanders consider themselves Danish while 90% see themselves as Greenlanders, typically a mix of Inuit and Danish. Basically, 90% of the Greenlanders are mixed (Kleemann 2018) and, for this reason, the expression 'indigenous people' is not employed in Greenland because most Greenlanders have Inuit and Danish ancestors. However, as interview findings confirm, there is one school system for all.

The government's motivations for driving educational reform are economic development and autonomy from Denmark. For example, from 2002, the curriculum subject called 'Christianity' was replaced by one called 'Religion & Philosophies'; the reason was to remove a term associated with the missionaries of Greenland's colonial period. However, language instruction was a key target of the larger reform process. Presently, the language of instruction is Greenlandic, while Danish and English are used in stages 8, 9 and 10. The reforms also introduced Personal Development Planning (PDP), in order to reorient learners to their future potential in the modern economy as well as to help them tackle social and psychological issues of a complex society based on multicultural asymmetries and educational mismatches.

Since the 18th of May 2015, the Greenlandic educational system has experienced a real transition because its most important educational department at University of Greenland's 'Institute of Learning' became a governmental entity (TMECCGE 2015). This institute is responsible for the education and training of new teachers/lecturers as well as for curriculum design and review at all levels. The Institute of Learning is part of the Danish government hierarchy and tasked with implementing a curriculum reform based on an important official report from the Greenland's Ministry of Education, Church, Culture and Gender Equality entitled 'The Education Plan II' (TMECCGE 2014a, b), which aimed at evaluating the Greenlandic curriculum and education system.

One of the resulting reform's main goals was to create a more flexible educational system in which high schools offered a common core curriculum with the opportunity to choose supplementary subjects based on students' individual interests and skills, in order to promote progression and retention towards tertiary education. In the Greenlandic government's view, it was important to educate the youth to prepare them for the labour market and to be active participants in Higher Education. Moreover, the government had in mind to establish more education programmes (professional bachelor's degrees) based on a more internationalized range of disciplines involving human rights, diversity and identity, environment and climate change. Until May 2015, the HE curriculum had been unchanged since the 1980s. Its core themes related to Greenlandic grammar, Greenlandic literature, Greenlandic history and political science within a Greenlandic framework, local social and gender issues but it ignored environmental sciences and its cognate disciplines. An important feature of Greenlandic HE has been an imbalance between a predominance of students in social sciences and small minority in technical and scientific disciplines. For this reason, the Government reforms also encouraged expansion of

Greenland Institute of Natural Resources at the University of Greenland. The aim was to enhance capabilities and reform curricula to provide students with knowledge of mechanisms and processes affecting their lives and livelihoods, such as rights to land, natural resources, economic activities and impacts of climate change. These were proposals that triggered the education reform process after May 2015.

An additional goal of this reform process was to reduce the cultural asymmetries and tension in the educational system by creating a culturally compatible educational environment that strengthens native Greenlandic culture and identity. This educational reform has proved more difficult to implement because, at ministerial level, the greater concern is for economic development and its stimulation.

In May 2017, it was possible to see the first concrete signs of a broader national discussion on Sustainable Development. This was materialised by Denmark's signature as a participant in the 'Fairbanks Declaration 2017' by signing the 'Agreement on Enhancing International Arctic Scientific Cooperation' (Arctic Council 2017). This was a true landmark in initiating a debate on Sustainable Development and on the United Nations' Sustainable Development Goals (SDGs) in Greenland with sight on improving economic and living conditions, efforts to reduce transboundary pollution (POPs) (de Wit et al. 2019) and black carbon, the value of sustained biodiversity monitoring (Arctic Biodiversity Assessment) and traditional knowledge, innovative energy and ICT infrastructure (internet), a research-focused curricula, data sharing on climate change indicators, and of course, the special focus on local updated assessment of snow, water, ice and permafrost (SWIPA 2008). These are guidelines that represent a shift in Greenland's perspectives on educational reform that impact not only the curriculum but also Greenlandic teacher training and qualification at a post-graduate level.

5 Greenlandic Higher Education and the Development of Sustainability Education

Greenland has experienced a process of evolution comprising a shift from a traditional subsistence economy towards a more market-oriented. Educational reform has similarly been linked to supplying the labour market and the promotion of trade and industry (EU Commission 2014).

The most important Higher Education institution in Greenland is the University of Greenland or *Ilisimatusarfik*, which was established in 1983 in the capital Nuuk and granted University status in 1989. The University's early activities involved delivering teaching and research in literature, languages, administration and theology (EU Commission 2014). A new board of studies was created by the Greenlandic Parliament in 2008 and, currently, the institution offers 11 university undergraduate degrees with individual courses in Danish, some in Greenlandic and a very few in English. In 2018, it enrolled 205 students and around 14 teachers, a small number, but many Greenlandic students choose to attend university abroad, especially in

Denmark. Since 2015, it has also hosted an international and interdisciplinary master's programme on 'West Nordic Studies, Governance and Sustainable Management', which has been developed in partnership with four official international partners. These are the University of the Faroe Islands, Nord University, University of Iceland and the University of Akureyri in northern Iceland.

Another key player in Greenland's Higher Education is the University of the Arctic (UArctic), a cooperative network of educational colleges and institutes, which aims to promote northern voices in the globalizing world and promote partnership between native and non-native inhabitants. UArctic's academic supporters include 143 member institutions, not least Dartmouth University, USA, University of Lapland, University of Oulu, Finland, and Memorial University, Newfoundland. UArctic has three members in Greenland. These are *Ilisimatusarfik* (University of Greenland), the Greenland Institute of Natural Resources, also located in Nuuk, a research institute established in 1995 that focuses on marine resources and climate change, and *Perorsaanermik Ilinniarfik* (College of Social Education), which is located in Ilulissat and teaches education, including preschool, child and youth care, social problems and social welfare. In 2017, the college co-hosted a conference on 'Reconciliation, Learning and Cultural Diversities' which was co-hosted by the Greenland Reconciliation Commission and that focussed on reconciliation and decolonisation.

Also relevant is the Arctic Technology Centre of the Technical University of Denmark (ARTEK), which is based in Sisimiut, Greenland's second town of some 5500 people located around 200 miles north of Nuuk. Since 2000, ARTEK has offered undergraduate courses in engineering and Arctic technology, Fishery Technology, as well as a Masters in Cold Climate Engineering. The Centre is a joint venture with *Teknikimik Ilinniarfik*, KTI (Technical College of Greenland), and aspires to recruit 200 students. Its courses in Arctic technology address important challenges related to the need of sustainable infrastructure and it hosted the conference on "Urbanisation and infrastructure in the Arctic – challenges to sustainability" in 2014 (ARTEK 2014), which dealt with 'the fundamental challenges of planning and building in a cold climate'. Typically, the languages of instruction are primarily Danish and Greenlandic, but again, since 2015, some courses are available in English.

During interviews, Greenlander respondents report that they see the curriculum, from pre-school to University as a whole, one body of components. Respondents also called attention to the curriculum's continuing lack of major alignment to the environmental sciences, except in very specific cases. Some natural science is taught, for example, in Sisimiut, where the engineering course includes elements of environmental science. However, more generally, the mainstream Higher Education curriculum still does not deal with either climate or wider environmental change or energy studies. Both documentary and interview evidence, obtained from the Institute of Learning in Greenland University, confirm that Environmental Education and ESD are not yet part of the Higher Education curriculum.

Environmental education does seem to be embedded – to a certain extent - in the Secondary and Primary curriculum. However, until recently, the Higher Education

curriculum had been unchanged from the 1970s and 1980s and preserved the concerns of those decades. In May 2015, significant changes were proposed to implement a greater focus on indigenous pedagogies, contextualization, cultural activities important for enhancing students learning and engagement (e.g. Inuit dance, art, music and craft), but these components are still insufficient in this curriculum. Indeed, the reforms of May 2015 proposed a more focused consideration of the ways that students learn, how to enhance learning and how to implement life-long learning in the Greenland context. Recently, these have started to be implemented, along with proposals to develop educators' training on how to teach multidisciplinary subjects (involving technical, scientific and sustainability know-how), an approach that has received more support from the Ministry of Education in concerted initiatives with international partners.

Most interviewees report that the May 2015 educational legislation is well-structured, but has just not been completely implemented because it is an on-process consisting in assessing gaps, accommodating needs and styles of learning and embedding sustainability. They feel that effecting its implementation to the point of being practiced will still take more than 20 years because the tutors need to be re-educated and re-trained, a notion which is resisted by many current tutors.

Throughout, interviews reveal a clear mismatch between the colonial and post-colonial mind-sets, which can only be addressed by adopting more culturally inclusive models of education. One possibility, that in one interviewee's opinion rendered positive results, is based on Vygotsky's socio-cultural theory (Vygotsky 1978; Fig. 10.8), and would include cultural elements of contextualization, personal development, personal worldview (family experience and roots), and collectivist communication (body language).

Documents and interview findings collected from the Institute of Learning include no reference to the word 'sustainability' in the curriculum (*laereplan*) or in the education system until levels 6 and 7 for 'historical reasons'. However, the term 'sustainability' does appear in a recently designed Higher Education curriculum on 'Environmental Change' but this is not yet embedded in the curriculum. This curriculum also emphasises life-long learning, which, despite being part of the legislation, is another concept in need of further development in Greenland.

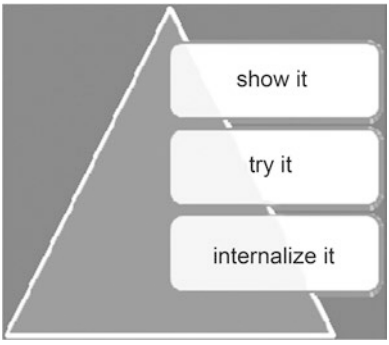

Fig. 10.8 Inclusive model of education
Source: Spindler (1997)

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Upper secondary education	281	288	347	330	356	457	544	480	506	542	551	611	576	510	490	500
Vocational education and training	703	642	566	689	658	719	722	751	842	795	777	802	802	890	836	811
Supplementary examination courses	46	49	57	64	63	67	81	85	115	93	121	132	125	114	113	103
Short-cycle higher education	50	49	75	58	63	82	79	82	73	86	85	114	107	126	123	145
Bachelors programme	87	78	89	87	99	95	115	133	120	141	149	133	149	136	123	125
Professional bachelors programme	133	143	138	158	145	185	158	217	267	258	215	278	263	212	165	222
Masters programme	15	20	24	27	38	22	33	44	35	36	47	45	54	49	57	42

Fig. 10.9 Enrolment in Greenlandic education system from 2003 to 2018
Source: Statistics Greenland (2019)

In terms of educational strategy, interviewees expressed the opinion that the government and the departments engaged in educational reform are on the right track. The number of students attending Higher Education has grown considerably and statistical data shows that a large percentage of the enrolment in vocational education supports emergent industries (Fig. 10.9). Statistics are positive in terms of the number of students that entered the educational system, the problem is to know how many will complete it and how many will adapt to the opportunities and challenges presented by Greenland's rapidly changing economy and society.

The reform carried out in 2015 promoted significant changes in the Higher Education structure and introduced important discussion on climate change, energy and environment in the context of sustainability. Interviewees believe that with the implementation of the new 'Environmental Changes' curriculum and through the newly launched degree programme on 'Society', these topics and their interfaces may become more comprehensively addressed in Higher Education, thanks in part to the influence of the United Nations' SDGs in 2017 and the signature of Fairbanks Declaration.

Meanwhile, Greenland Ice Sheet predictions combined with specific cases of pollution and the visible effects of climate change have initiated an intense local debate on how to teach people, both locally and around the world, how to deal with climate change and other environmental challenges. A pilot study was conducted recently to examine educators' perception about climate change and environmental issues in Greenland because, as it was reported, there is a misconception about these topics in the local media. This suggested that Greenland's educators may be concerned about climate change, but this is less true of the common citizen, as the volume and types of waste seen in the streets of Nuuk and Ilulissat demonstrate. To effect change, educators need to be enabled to teach about the subject in theory and to be engaged with practice. Fieldwork reveals that, while there is a need for teaching the theory and practice of climate change, environment and sustainability, there are obstacles in the way, which include language issues and the lack of suitable professional training for teachers. This study included data from a roleplay among a group of four educators on the subject of hydropower and how it works in Greenland. Basically, the roleplay revealed that among the few participants that attended the session, one didn't understand, one understood but couldn't explain the

theory, one understood but was not able use the information in practice, while just one could explain and apply the material. The study demonstrated the challenges of teaching and training Greenland's educators and students in the absence of contextualization and a holistic view on local drivers of change. It was concluded that the real problem (in terms of the number of students in HE) was not the students but their tutors, who were trained long ago in the Danish system and hadn't adapted to the new requirements of a changing educational system and the local drivers of change including clear notions of Sustainable Development.

Sustainable Development and education have an intrinsic, interdependent relationship with each other, largely because no sustainable society can operate without high quality education as well as human development being intrinsically linked to education standards (AHDR 2004, 2015; Poppel 2015). Curricula which only focus on key competencies for the world of paid employment is deficient (Marsh 2009) because learners are persons not only industry professionals. ESD is a vision of education that seeks to balance human and economic well-being with cultural traditions and respect for the earth's natural resources. ESD involves "methods and approaches to develop lifelong learning; fosters respect for human needs that are compatible with sustainable use of natural resources and the needs of the planet; and nurtures a sense of global solidarity" (UNESCO 2005, p. 2; Ryan 2011, p. 3).

The positive aspect is the fact that these challenges have triggered an articulated process of cooperation among national and international stakeholders (scientific, academic, corporative) to allow for the establishment of scientific study programmes and the expansion of physical capabilities as laboratories, research institutes, business incubators that have been strengthening multidisciplinary research within society, environment and health as well as giving advice on the sustainable use of natural resources.

6 Conclusion

The local and global implications of the melting of Greenland Ice Sheet and the benefits and costs of a complex and changing Greenland with the multitude of interfaces and impacts on different local and global systems represent an important stimulus to advance Greenlandic Higher Education. A systematic multi-sectorial approach for enhanced research and monitoring efforts that expand understanding of the development process and impacts on Greenlandic ecosystems and society is needed to provide a range of adaptation options and the effective engagement of stakeholders including communities, policy-makers, educators, industries and common citizens. This initiative must go beyond the narrow curriculum versing about environmental management and infrastructure development impacts. It requires a concerted participation of stakeholders, information sharing, and local knowledge co-production framed by an inclusive, comprehensive and systematic sustainability governance and educational policy.

Capacity building and education oriented to sustainability are key components to start designing the future of a more balanced Greenlandic development model. The educational shift in direction promoted by the 2015 educational reform associated to the introduction of the United Nations' Sustainable Development Goals debate in 2017 are the beginning of a process that could be consolidated by the introduction and adoption of Education for Sustainable Development (ESD) parameters.

Higher Education has a pivotal role in promoting the transition from an environmental impacts' perspective – based on the extractive industry mind-set - to a well-structured and articulated sustainability perspective based on the knowledge, dissemination and application of the Sustainable Development Goals (SDGs). It would be through the UNESCO ESD framework that this sustainability perspective can be shaped and practiced in the Greenlandic educational system as a whole. An educational system based on ESD can contribute to analyse the comprehensively complex contexts and drives of change in course through multidisciplinary research, cultural inclusiveness by addressing the urgencies of the present and the needs of the future under a durable and long-term perspective.

Recommendations to enhance Higher Education in Greenland would involve promoting collaboration between Greenland's educational institutions and communities to break historical patterns, de-colonize the curriculum and prepare the nation for an uncertain but more self-created and independent future. Recommendation one would involve stepping further away from long-established, one-sided, colonial education and co-constructing a new educational structure at the interface between Greenlandic modernity and its traditional knowledge systems through culturally compatible education (Wyatt 2009). This would encourage more young people to engage with Higher Education and build the skill-base that Greenland needs (Kahlig and Banerjee 2007). Recommendation two would be to enhance teaching and learning about the interconnections between social sciences and environmental sciences, technical and scientific knowledge creation, to ensure the delivery of an Arctic education that is both relevant and interdisciplinary and that delivers knowledge and competences in the fields of climate change adaptation, polar research and monitoring systems as well as benefits for the new economy.

Finally, it is essential that Greenlandic Higher Education does more to develop a greater understanding of what Sustainable Development means for the wider community of Greenland; how it might support its population, economy and sensitive ecosystems and how it may be possible to promote and achieve the SDGs. It will be necessary to evaluate the educational system as a whole and apply mechanisms to assess levels of adherence to Sustainable Development Literacy (SDL) and to start the process of embedding ESD into the mainstream curriculum by integrating insights from Greenland's specialised institutes of polar research into the content, approaches, curricula and pedagogies of education using the life-long learning educational model. This could be the start of a new era for autonomy, education and self-determination.

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