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Nanotechnologies: challenges and controversy on the way to scientific citizenship, new emerging identities and intellectual consumption.

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Abstract

The world has gone through historical processes that are dramatically and rapidly transforming our social and business environment, producing far-reaching effects on our life styles and our habitat. People all over the world have become increasingly interconnected and interdependent. This aspect could potentially raise greater awareness of the fact that we are all part of a single community that shares a common human identity as a background and destiny.
There are, in addition, many experiences and technological advancements which are taking us away from 'the world we live in' towards 'the world we want to live in'. Technological progress, especially related directly to basic human rights, needs to be accessed by all consumers and given priority over economic interests, thus contributing to equal opportunities.
On the other hand, current developments in scientific and technological research raise a number of ethical questions comprising responsibility. Areas of research as nanotechnology and biotechnology, regarding food, healthcare and environmental issues, elicit complex and undeniable debates within society today.
*Our previous research on Nanoeducation has revealed a low level of scientific knowledge in Latvian consumers. The results stimulated the initiation of the project '**A**dopting **I**ntellectual **L**ife **A**pproach' (AILA) at Information Systems Management University (ISMA), Riga, Latvia. The aim of this research, focusing on the challenges of nanotechnologies in the food and healthcare sectors, is to explore Latvian intellectual consumers: their habits, new technology perceptions, preferences and values. Intellectual consumption is viewed as an identity project since we will study how Latvian citizens of the recession times construct their identity based on intellectual ethical consumption practices.*

Keywords*: Nanotechnologies and nanoproducts, scientific citizenship, intellectual identity, intellectual consumption.*

1. Education for new emerging intellectual identities and scientific citizenship

The current economic crisis has provoked a growing consensus that the 21st century consumer society is on a path that cannot promise its citizens a hope for sustainable future. The prevailing forms of political economy are failing to guarantee the consumers economic stability, preserve ecological resources and services, reduce social inequality, maintain cultural diversity, and protect physical and mental health of citizens. We face related crises of educational, social, cultural and personal sustainability.

However, what we witness today is that higher education is not about understanding reality but about accumulating knowledge through individual subjects which are disconnected from each other and decontextualized. If we want higher education to become an intellectual engagement that goes beyond the study of specific issues inserted in a single and minor subject within the broader context of compulsory curricula, it needs to adopt Development Education (DE) in order for it to become the most efficient and effective response to today's challenges (Bourn, 2009).

Development Education is an active learning process based on the values of welfare for all, equality, inclusion and cooperation. It presents people with an opportunity to set on an educational journey that starts from a basic awareness of sustainable human development, the priorities of international cooperation, passes through the understanding of the causes and effects of global issues, and ends with a personal commitment through informed action. It encourages a full participation of all citizens against exclusion and towards the influence on economic, social and environmental policies at both national and international levels, so that they are fair, sustainable and based on respect for human rights (Bourn, 2009). It is the concept that supports a new model of citizenship based on the full awareness of the dignity which is inherent in every human being, on his/her belonging to a local and global community and on his/her active commitment to obtain a society that is more just and sustainable.

Adopting more sustainable forms of political economy involves the establishment of new forms of governance guided by new emerging forms of intellectual identities and scientific citizenship. Educational means, objects and contents that feature such identities and citizenships should lie at the heart of higher education practices linked to the concept of Development Education.

Education and personality development are closely interdependent and have very much in common, although pedagogical science distinguishes between these two notions. Educational content includes knowledge and awareness of its place in the scientific environment, as well as learning strategies and metacognitive strategies.

Developmental content deals with the awareness of moral values, norms, rules, laws and ideals. Education has to do mostly with the intellect, whereas personality development appeals to motivational and needs spheres of an individual. Both processes influence consciousness, behaviour, emotions and determine the development of a personality.

Furthermore, the entity of the process, the unity of education and a person's identity development constitutes the main methodological principle of citizenship education, which is especially topical at present. A person's identity relates to self-image, self-esteem, and individuality. Weinreich gives the definition of a person's identity 'as the totality of one's self-construal in which how one construes oneself in the present expresses the continuity between how one construes oneself as one was in the past and how one construes oneself as one aspires to be in the future' (Weinreich, 2011).

The inclusiveness of Weinreich's definition directs attention to the totality of one's identity at a given phase in time and assists in elucidating component aspects of one's identity system, such as one's gender identity, ethnic identity, literate identity, occupational identity, intellectual identity, and so on. Thus, as one aspires to be in the future will differ considerably from the present phase according to one's accumulated knowledge and experience, or, in other words, according to one's developed intellectual identity.

However, this essential knowledge is not inherited or static or will be developed by chance. It has to be developed by strategic, targeted teaching. Hence, scientific

citizenship education cannot be restricted to a separate subject. It has to be pervasive – to constitute an integral part of all education and it has to be lifelong – continuing throughout life.

Based on our definition of an educational system (with the Systems theory at its heart) as an organized wholeness of interactive subjects with constant feedback ties, which presupposes the appearance of new emerging qualities in the process of interaction through communication (socialization), we can assume that some qualities appear as a result of self-organization. Thus, the foundational idea of the systemic approach is that of intellectual *self-organization* of an individual within an organized intellectual system. Educational process does not develop only intellectual potential of a student, but personality as a whole, leading to individualization of personality through educational socialization.

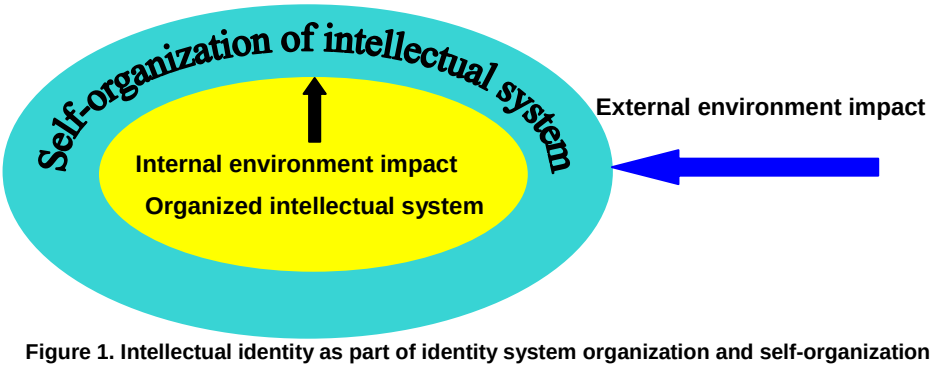


Figure 1. Intellectual identity as part of identity system organization and self-organization model.

As an example, we can consider an intellectual identity system (IIS) of an individual. This system develops/intellectualizes and self-organizes within a bigger organized intelligent system. (Figure 1). An individual, as a social being, educates, forms and develops his personality and his intellectual identity as part of his identity system through interaction and communication.

In the model (Figure 2), the dynamics of an intellectual system development can be presented as an informationally-developing system, where every new amount of adapted educational information leads to the acquisition of a new 'zone of proximal development' (Vygotsky, 1991). As a result, with every stage of intellectual development a person reaches a qualitatively new system of identity and scientific citizenship development with the appearances of new emergent characteristics.

2. Construction of new emerging identities, shaping scientific citizenship through intellectual consumption practices

Humans are unique in their ability to reflect on themselves. Nowadays a number of scholars point out that human self-conceptions have a history and are constantly changing. Ideas of human nature and, ultimately, identity have always been shaped by the integrated concepts of philosophy, education, science, and technology. The fast scientific and technological advancements in such areas as neuroscience, genetics, artificial intelligence, biomedical engineering, computer and communications technology, biotechnology, and nanotechnology call for fresh reflections on what it

means, in the 21st century, to be human, and for ethical judgments on how we might shape our intellectual identity and scientific citizenship on the way to sustainable future consumer society.

We want our students to leave university with a clear understanding of the political, legal and economic functions of the society they live in, and with the social and moral awareness to thrive in it. Citizenship remains a crucial way of organizing people's place in the contemporary world. It will undoubtedly continue to change meaning across space and time in the twenty-first century.

Therefore, shaping scientific citizenship is viewed today as the development of civic skills contributing to the sustainable future by enabling people to make their own informed decisions about highly complex problems of the day, to take responsibility for their health, their own lives and to contribute to the wellbeing of their communities.

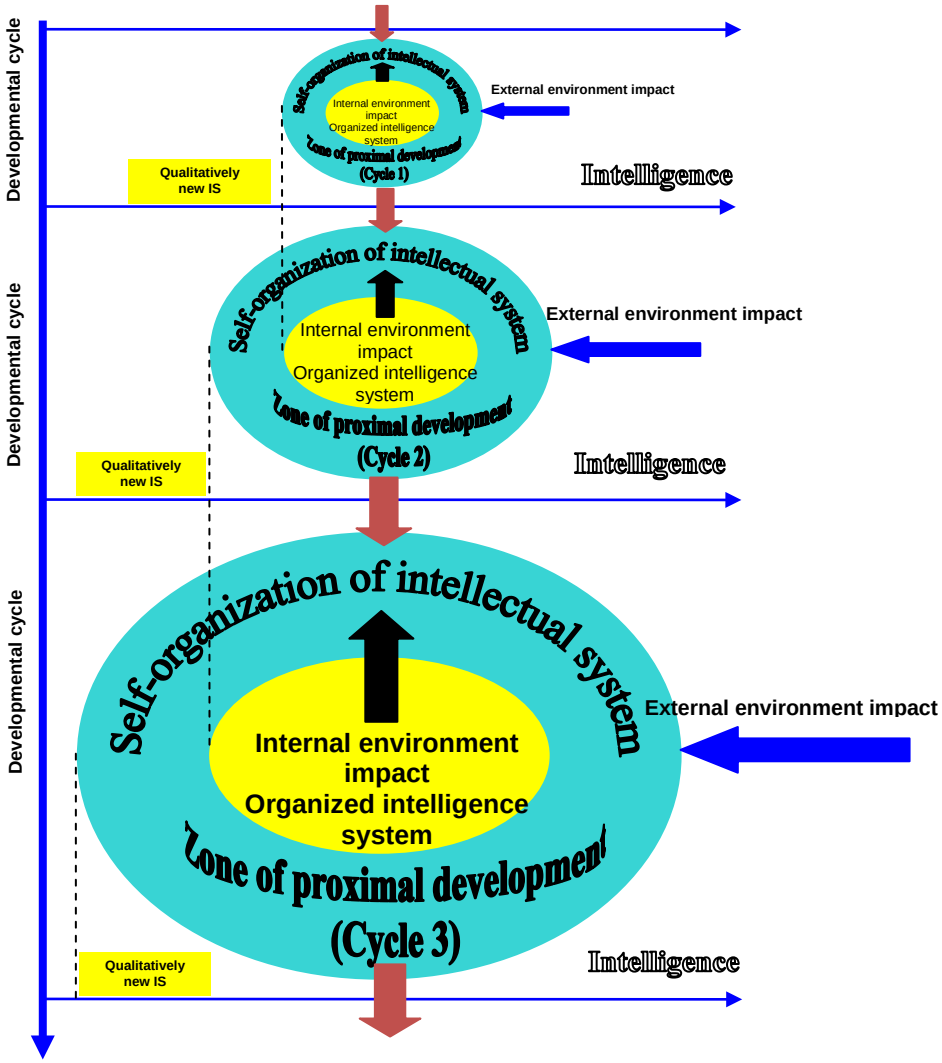


Figure 2. The dynamics of an intellectual identity system development.

To fulfil the task, it is the job of our higher educational systems of the 21st century to prepare young citizens for the challenges and controversies of the rapidly changing and diverse consumer societies and highly technologically empowered economies. It is the role of education to develop skills and values required to enhance democratic life for everyone comprising both rights and responsibilities, and making their informed citizen voices heard in policy decision-making. Democracies need knowledgeable problem solvers and responsible decision makers.

This is why we need to consider the role of new technologies in students' daily lives and their implications for classroom practices. How closely, for example, should students' worlds outside the classroom match what occurs in the classroom? Why is it important to develop intellectual consumer identity and scientific citizenship?
Intellectual citizens are people showing power of the mind to reason and acquire knowledge, who are capable of *learning* through connecting, of *doing* through thinking, of *living together* through awareness, of *changing* through understanding.
This is why there is a need to change the central vision of education and to reconsider its function in its entirety: namely as the complete development of a person, who needs to learn how to be, to think, to feel and to act.

All of us are human beings and our human identity is the most essential factor that unites all people of the world (Figure 3). At the same time, all of us are consumers: we consume goods and services, and our consumer identity is another major factor making up our commonality. But against the background of this commonality, we develop different consumption practices due to various reasons – botnh objective and subjective. Still, on the subjective side, it is, to a great extent, our intellectual power that shapes our life style and contributes to the quality of life.

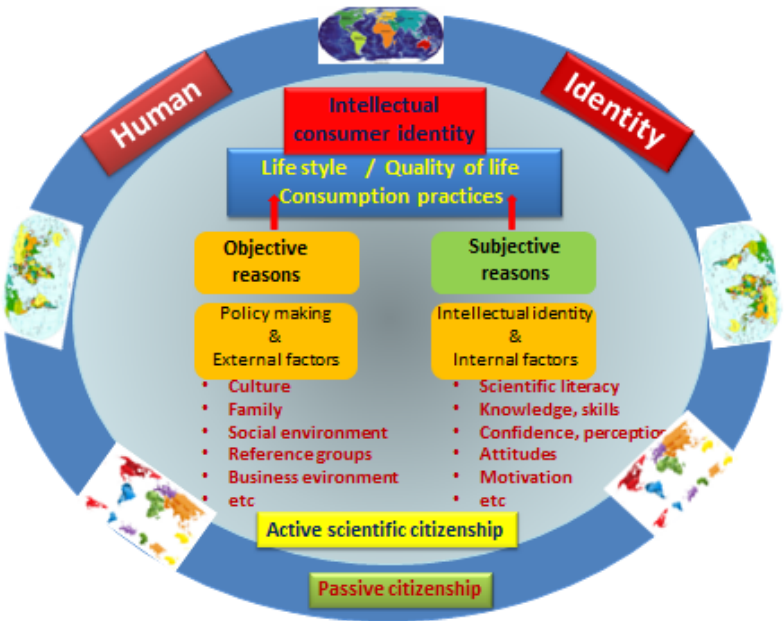


Figure 3. Construction of new emerging identities, shaping scientific citizenship through intellectual consumption practices.

It means that we need to have enough knowledge, skills and confidence to construct our intellectual identity and scientific citizenship effectively with the intention to contribute to innovations, sound business practices and facilitation of responsible and informed policy making to satisfy the requirements of individuals as well as contributing to the improvement of the quality of life. Education, as a major catalyst, has to help people become effective scientifically literate citizens. The cost is much greater if it does not.
The rise of consumer culture and the increased scientific literacy can be to a certain extent equated with enhanced citizenship, i.e. scientific citizenship, since a scientifically literate public can better contribute to policy making. Thus, the notions *citizen* and *intellectual consumer* become almost conflated, or, at least, harder to differentiate.

Development Education (DE) suggests that higher education is the primary agent of transformation towards sustainable development since it can foster the required values, behaviours and lifestyles. It recognizes, however, that there can be no universal model of DE. Each country has to define its own priorities and actions, with goals, emphases and processes that are locally defined to meet local conditions. As quality education DE supports a rights-based approach and technological literacy in contemporary consumers, develops the learner's competence as a community member and global citizen as well as an individual and family member, it also addresses the context of social desirability of innovations looking into processes of technical modernization, changes in the interface between humans and products and ethical issues concerned with the boundaries of intervention into the environment and the human body.

3. Bridging the technological literacy gap in Latvian students: AILA Project

Higher education today is the ability to perceive hidden connections between disciplines. It seems, thus, unrealistic to think of nanotechnologies as of a single technology and to consider nanoeducation totally the privilege of natural or technical sciences. Alexandersson (2012) argues about the division of education on theoretical and practical subjects and emphasizes that the ultimate goal of higher education for sustainable development is to empower citizens with the perspectives, knowledge, skills, and understanding of new technologies for helping them adjust and live in democratic sustainable societies. A growing gap between technology use and technology understanding in a consumer society creates a need to educate students about new emerging technologies - the backbone of a strong economy.

Being avid consumers of products, contemporary Latvian youths are very familiar with their wide variety due to the efforts of marketing campaigns, advertising media and their own use of the Internet. However, as they buy and use today's products, they hold no concept of how these products come to exist or how they are made. Overall, general public's knowledge of the production process is relatively limited; also its perception is really outdated (usually stuck in mass production concepts) and unappealing. This lack of knowledge creates a strong demotivating barrier that prevents many potential students from not only entering, but even considering the field. Such a knowledge gap creates a need to educate the students about what constitutes a modern production process enhanced by new technologies, particularly, nanotechnologies, and intellectual consumption.

In this paper we describe an effort to bridge the technological literacy gap in consumer citizens, currently under way in Latvia. Our previous research on Nanoeducation has revealed a dramatically low level of scientific knowledge in Latvian consumers. The results stimulated the initiation of the project '**A**dopting **I**ntellectual **L**ife **A**pproach' (AILA) at Information Systems Management University (ISMA), Riga, Latvia.
The aim of this research, focusing on the challenges of nanotechnologies in the food and healthcare sectors, is to explore Latvian intellectual consumers: their habits, new technology perceptions, preferences and values. Intellectual consumption is viewed as an identity project since we will study how Latvian citizens of the recession times construct their identity based on intellectual ethical consumption practices.

AILA Project is an interdisciplinary task based on diverse skills. The project covers interdisciplinary strategic priority areas: food and healthcare systems. This project is especially addressed to students for understanding a potential influence of new emerging technologies on diverse and (r)evolutionary changes in the human life. A set of activities will help students explore the impact of nanotechnology in their own lives by examining products from foods, healthcare products to various coatings and packaging, which employ nanotechnology in various ways.

The beauty of AILA is that it reaches students from all study programs – Natural sciences and Humanities, Information technologies and Business studies, Tourism and Management, Law and Environmental design, etc. It is an integrated skills project built around active learning methods to promote an active discussion-based approach to developing responsible scientific citizenship, new emerging identities, and to offer an opportunity for students from a wide range of disciplines to learn about nanotechnologies, to explore their risks and benefits and to reflect on the place of nanotechnologies in their personal life, in their future professional practices, and the modern consumer society.

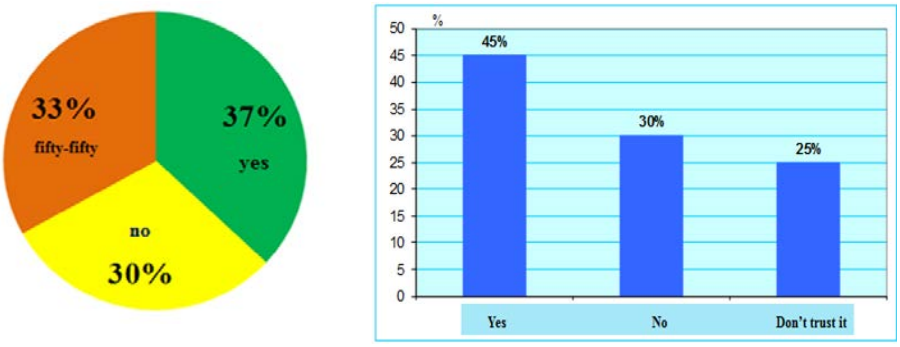
The interdisciplinary character of all problems, the overlapping of humanities with natural sciences, and the necessary dialogue between scientific and citizenship points of view are key components of the nanoproject. The research has engaged the students to take part in creative activity seeing the role of R&D teamwork in new emerging technologies implementation and commercialization.
A questionnaire for the consumer survey comprising a set of questions was compiled based on a Likert Technique or scale and supported by the Consumer Culture Theory by Arnould and Thompson (2005).

The main findings of the research are threefold as there were three teaching objectives of investigation: 1) what level of scientific understanding and risk-assessment would be sufficient for consumers; 2) whether consumers are provided with the necessary information; and 3) what more needs to be done in terms of public engagement. The empirical results have proved a dramatic discrepancy between nanotechnology use in products that are already on the market and lack of nanotechnology understanding in a modern Latvian consumer society.

The question arises: does higher education today fulfil its role as a major catalyst to provide the necessary knowledge and relevant skills mix for our students to be prepared to join the highly technological global economy to ensure sustainable future for themselves, in the first place?

To find the answer to this question, we initiated a pilot research with the second-year students as an educational supplement, as a part of market analysis of a particular product that the students are learning how to make (see, Figure 4).

The first question addressed to the respondents was whether they considered themselves 'intellectual consumers'. As we can see from the pie chart, the answers divided almost evenly among the three groups of students-consumers with a slight shift toward 'intellectual consumer'. Thus, we had to investigate the reasons for 30% of students considering themselves non-intellectual consumers and 33% being doubtful about themselves.



(a) (b)

Figure 4. a) Do you consider yourself an 'intellectual' consumer'? (N=120); b) Do you understand the 'labelling' information?

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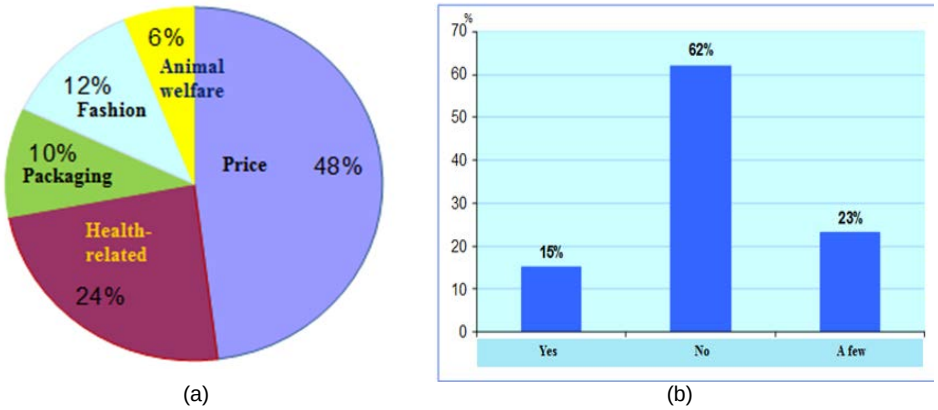
As the bar graph demonstrates, the reasons behind such a low self-esteem and doubt are hidden behind the inability to cope with complex scientific inscriptions on the products revealing their ingredients – 30% of students confess not being able to understand all of them. Another 25% of students admit to be very sceptical about information accompanying products because many companies do not label nanoingredients or other unhealthy components for people to choose whether to buy such products or not. Moreover, scientific-technological research and investments in different areas often serve the interests of those who finance the research itself, whilst forcing those who use these products into commercial traps, often without any information regarding the effects they may have on consumers' health (see, Figure 5).

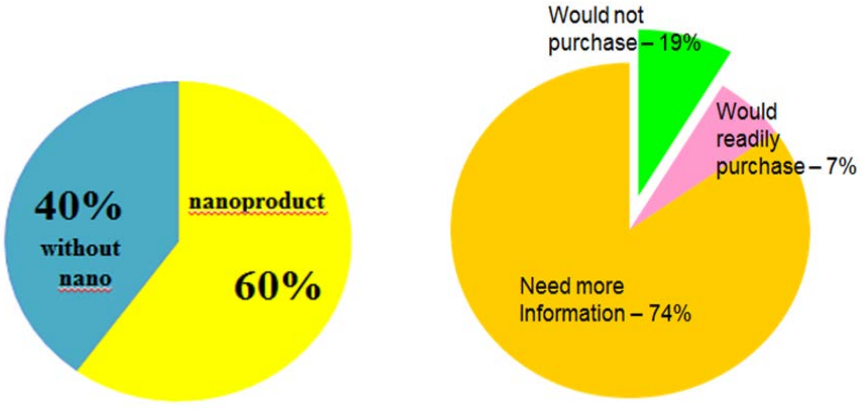


(a) (b)

Figure 5. a) On what information do you base your purchasing decisions? b) Do you know what products contain nano-ingredients?

As we can conclude from the pie chart, the major part of consumers is influenced by price in making their purchasing decisions. On the one hand, it seems to be a quite reasonable and rational approach. On the other hand, taking into account a relatively low level of the living standard in the country, this factor might cause some worry. The second biggest category – 24% of consumers put their health on the first place, which is very reasonable.

Still, judging from the bar graph, the plurality – 62% - have no idea about products containing nano-ingredients, hence we can assume that they cannot make responsible decisions concerning their health. Only 15% of students-consumers say that they know what products contain nano-ingredients. Though, if we sum up 15% and 23% (of shy students, perhaps) we will get that 38% who consider themselves intellectual consumers (see Figure 6).



(a) (b)

Figure 6. a) If there is a choice: will you buy a product enhanced with 'nano' or without 'nano'? (initial assessment); b) Consumers' impressions of the risks versus the benefits of nanotechnology (after a general course on NTs)

Among students-consumers who make an initial assessment of nanotechnologies, the plurality think the risks and benefits will be about equal, and the votes are divided about evenly between benefits and risks – 60% and 40% respectively. But when potential risks and benefits are outlined in the general introductory course into nanotechnologies, the greatest shift is toward the need of additional information – 74% or risk – 19%.

As we can see, life itself imposes the necessity of knowledge and education to make informed choices and responsible decision making, thus, ultimately becoming intellectual consumers.

The higher educational system needs to reclaim its human and global dimension, give sense to our lives, our actions and our relationships and be responsible for building a just and sustainable world.

We are in favour of an educational system that can stimulate a student to have a broad understanding of himself and of the world, whilst also offering elements that enable him to contribute towards a morally and physically healthy society. In short, it means that we need to change the school into a place of exchange, reflection, socializing and planning that promotes knowledge as a collective construct, that values the knowledge and experiences of all actors in the educational community and not, therefore, as a mere individual strength. This means that we need to change the educational system until the university itself and the curriculum become a learning and participative 'community' in which students, teachers, industries, local governments, associations and NGOs can be integrated. The educational system needs to change with regards to today's challenges, thus becoming part of the solution and not the problem.

4. To move with the times and to build the future

Despite steadily increasing dependency of modern societies on technology, society-wide understanding of technology (necessary, for example, in informed and critical decision-making) is usually lacking. Since about **70** percent of Latvians are past the school age, updating their technological literacy requires access to opportunities outside of formal education. Younger generations have yet to develop their technological skills and interests, but opportunities for that in a structured, pre-university and university (non-technical) education are limited. The importance of inducing technological literacy and interests in younger generations cannot be overstated, as it impacts future supply of engineers, scientists, and integrated managers.

Since Nanotechnology is starting to play an extremely important role in the socio-economic development of all countries it is imperative for higher education that emphasis be placed on producing a properly educated, qualified and trained manpower that can cater for the future of the society they live in, to be guided by teams of teachers from a diverse array of disciplines: language arts, sociology and history, civic and political science, natural sciences and technologies. Therefore, science and technology teachers will have to learn humanities and social sciences. Humanities and social science teachers will have to learn sciences and technologies. It means that every subject teacher has to reconsider the course he is teaching and possibly find a place to reflect on the impact of new technologies on the quality of life.

A new interdisciplinary nanoeducation course, developed at ISMA, places an emphasis on humanitarian applications of new technologies by focusing on the role of nanotechnologies in tackling society's grand challenges such as safety, health and environment. Our hypothesis is that this new approach to teaching about technologies will engage and inspire students who have typically been turned off by the traditional educational experience. Additionally, we believe that this course will better prepare a new generation of specialists to address major societal problems in the future maintaining at the same time an awareness of political, economic, ethical and social constraints on technologies.

Therefore, concurrently with the nanoprojects and general nanoeducation courses, subject teachers have been involved for the past few years in projects that complement nanoeducation with a special emphasis on citizenship education to be able to teach students to move with the times and stay abreast of the fundamental knowledge of the day in order to understand what is at stake and participate in key social debates and informed decision making.

The teaching objective of these academic activities is to create an openness of mind and criticism of thought in students for a very broad range of knowledge. This will help them position themselves within the vastness of current scientific knowledge and technological development that is shaping our modern society — scientific knowledge and development that could have major consequences on the fundamental way we see intellectual consumption, scientific citizenship and the sustainable development of the society we live in!

We challenge the students to broaden their horizons and give them ways of acquiring knowledge of things that shape society. We hope to interest them as citizens so they would be curious about the state of current knowledge, regardless of their discipline. We want to prepare them to follow the evolution of knowledge; to be an active citizen today and to speak knowingly on questions dealing with quality of life within local societies and globally.

Conclusion

The importance of inducing technological literacy and interests in younger generations cannot be overstated, as it impacts future supply of engineers, scientists, and integrated managers. Crucial ethical questions arise with the development and teaching nanotechnologies. How can we bring together technosciences and progress with the humanosciences and responsibility to favour all consumer citizens and the planet?

Today there are opportunities to create new intellectual spaces and to motivate critical thought, democratic transparent debate, to offer alternative problem solutions, to exchange experiences and to join efforts in knowledgeable decision making. It is at this crossroads and the questions raised by the scientific and technological advancements of our contemporary world, that we need to transform the society by educating responsible decision-makers and contributing to the construction of new emerging identities, shaping

scientific citizenship and lifestyles through intellectual ethical consumption. Our choices today will determine what kind of tomorrow is likely to come.

This requires a revision of many existing curricula and the development of objectives and content themes, and teaching, learning and assessment processes that emphasize moral values, ethical motivation and ability to work with others to help build a sustainable future. Viewing education for sustainability as a contribution to a technologically literate society is central to the reformulation of education and calls for a 'new generation' of theory and practice in education and a rethinking of many familiar approaches (Alexandersson, 2012).

When we do not pay close attention to the decisions we make, when we fail to educate ourselves about the major issues of the day, when we choose not to take responsibility and not to make our voices and opinions heard, that is when citizenship and democracy breaks down.

References

Alexandersson M., Dimenäs J. (2012) Crossing Disciplinary Borders: Perspectives on Learning about Sustainable Development. Journal of Teacher Education for Sustainability. 14, 1, pp. 5–19.

Bourn, D. (2009) Creating Global Citizens? Awareness Raising, Learning and Informed Action: Young People and Development Issues. London: EU University of London, Development Education Research Centre, Institute of Education

Lobanova, T. and Shunin, Y. (2009) Language as a social behaviour: integration of language, communicative competence and identity development, in Ross, A. (ed) Human Rights and Citizenship Education. London: CiCe, pp. 306 - 312

Lobanova-Shunina, T. and Shunin, Yu.N. (2011a) Nanothinking as an Essential Component of Scientific Competence and Social Responsibility in the 21st Century Society. Computer Modelling and New Technologies. 15, 1, pp. 58-68

Lobanova-Shunina, T., Shunin, Yu. (2011b) Nanothinking as a Concept of Citizenship Education for the 21st Century Europe, in Cunningham P. and Fretwell N. (eds) Europe's Future: citizenship in a changing world. London: CiCe, pp. 345-355.

Vygotsky, L.S. (1991) Thought and Language. Cambridge, MA: MIT Press.

Weinreich, P. (2011) Incorporating emics within etic parameters. International Journal of Intercultural Relations. 34, pp. 124-139