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Unconscious Awareness

► Effects of Intuition, Positive Affect, and Training on Creative Problem Solving

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University (Research University)

► Higher Education and Innovation

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University Research and Innovation

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From the Linear Model of Innovation to Complex Networks

The role of university research in innovation processes has been discussed in innovation research and policy since about the 1950s. In the beginning, to a large extent the debates took place in the United States, but eventually European scholars and policymakers followed suit. Through international organizations, in particular the OECD and the World Bank, the whole discourse has become so widespread and globalized that research conducted in universities and its contribution to technological innovations are currently emphasized in very different and heterogeneous regions and national systems of the world. Roughly, one can distinguish between two different conceptualizations over time. In these conceptualizations, the role of university research and its carriers shifts from being merely a provider of basic knowledge to a more complex picture, in which active networking and entrepreneurship are seen as equally important.

According to the linear model of innovation that was dominant until the 1980s, universities

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were mainly responsible for carrying out basic research. Based on this input, applied research and development would eventually follow and lead to product and process innovations in industry. In this model, university research does not contribute directly to innovations. The link is rather indirect and mediated through different stages, and the boundaries between the academic sphere and the economic sphere seem to be clear-cut. Likewise, university researchers do not actively engage themselves in entrepreneurial activities that take place in the business sector. While innovation in business firms requires managerial capacities and overall planning processes, basic research as an invaluable resource is inherently uncertain. It requires creativity and inventive behavior that can neither be planned nor managed. Another marked difference between the academic sphere and the economic sphere is seen in the public character of university research. According to a seminal paper by Nelson (1959), due to the inherent uncertainties in basic research and the related difficulties in expropriating individual benefits, firms tend to underinvest in basic research. Therefore, publicly sponsored basic research at universities serves best in providing national economies with a sufficiently strong knowledge base on which firms can rely in order to develop marketable innovations. This strong case for basic research as the main function of universities in innovation processes has been confirmed by subsequent research. In particular, Mansfield (1991) has given evidence of the importance of basic research to industrial innovation. With data from different industries, he shows that academic research has led to considerable innovation in industry, in particular the pharmaceutical sector, within the rather short time span of 15 years. However, as the effects of basic research on industrial innovation are more widespread and rather long term in character, Mansfield and other innovation researchers assume that such measurements only grasp the tip of the iceberg of universities' contributions to innovations in industry. For a long time, these arguments provided the rationale of research and innovation policies in technologically advanced countries. By heavily funding basic research and its main location, that is, universities, a public knowledge stock was created, which could be tapped by industry to ensure national economic progress.

Over time, however, such policies were met with increasing skepticism. In particular, the idea that basic research more or less automatically falls out or spills over from the academic to the industrial sphere became a target of much criticism. The fact that potential users have access to public knowledge does not guarantee the use of this knowledge. This holds particularly true for small and medium-sized enterprises which hardly have the "absorptive capacity" (Cohen and Levinthal 1990) to appropriate academic research. Taking these limitations of the linear model of innovation into account, better linkages between the different stages of the innovation process and the actors involved were asked for. Where university-industry relations are concerned, this implies that academic researchers and universities are expected to get actively involved in the process of knowledge transfer. In addition, transfer is no longer conceptualized as a one-way street leading from basic research to industrial application. Rather, academic researchers engage in cooperation with industrial partners, learn about the needs of their partners, and redraw their research agenda accordingly. The most visible sign of this conceptual and policy turn was the creation of offices for knowledge and technology transfer at universities. Since the 1970s and 1980s, such offices were created at universities in most OECD countries in order to tighten the linkages between university research and industrial application. In this, a more direct role of the university and academic researchers in the innovation process was acknowledged. However, the high hopes that led to the institutionalization of transfer offices in most cases were not met in practice. The effectiveness of transfer offices was questioned by studies and assessments which revealed a huge variation with regard to the number of staff, the size of transfer offices, the actual task structure, and the degree of professionalization of staff

members. In a review of literature on the experiences made with transfer offices in the United States and Europe, Geuna and Muscio (2009) reveal striking similarities and differences concerning their institutionalization and success. Though technology transfer has become a strategic issue in the governance of university-industry relations in all countries observed, the success rate of transfer offices is highly uncertain and depends on critical factors like the importance of management experiences of staff, a critical size of the office, and close interactions with academic researchers already in the early stage of the invention. But even if these conditions are met, there is hardly any common formula for success as context-specific aspects prevail.

Furthermore, the embeddedness of transfer offices in university bureaucracy, their culture, policies, and inflexibility can be a serious barrier to effective knowledge and technology transfer. An even more systematic and fundamental limit to the effectiveness of transfer offices lies in the fact that knowledge and technology transfer between universities and industry is a highly personalized process. Transfer offices can act on behalf of university researchers, but they can hardly substitute their active involvement in innovation processes which span the boundary to partners in industry. This problem is two-faced. On the one hand, university-industry relations require a high degree of trust between partners from both sides. Trust building is a tedious and iterative process among those persons in university and industry who are actively involved, but not among organizational units. On the other hand, research implies a high degree of very specific expertise consisting of formal and tacit knowledge which also requires the active involvement of researchers. Staff members of transfer units can support such activities, but they can hardly substitute the direct engagement of university researchers.

The creation of transfer offices did not alter the traditional images and differences between the university as the main locus for basic research and the industrial firm as the main locus for generating innovations for the market. However, this changed from the 1980s onward as the university and individual researchers were increasingly seen as economic actors themselves. In becoming entrepreneurial, traditional identity concepts are transcended, both at the organizational level of the university and the individual level of the researcher. Furthermore, university research is no longer regarded as the starting point of a linear model of innovation, but instead as an integral part of highly complex and nonlinear innovation networks in which the difference between basic research and commercialization activities becomes increasingly blurred. Like in the previous phase, in which stronger ties between university research and industry were sought through transfer offices, research universities and federal policies of the United States pioneered such transformation processes. An important legislative milestone was the Bayh-Dole Act in 1980 which entitled universities to patent and to issue licenses to inventions developed with federal funding. Its actual impact on the rise of entrepreneurial activities of universities and university researchers, however, is contested. Mowery et al. (2004) argue that the Act has had only very little real effect on such activities. Nonetheless, its highly symbolic value has beyond doubt granted legitimacy to directly involving universities and university researchers into commercialization and market-like behavior in innovation processes. In particular, universities with a strong research base and faculty in the life sciences and in the field of information and communication technology were spearheading this trend. Shapin (2008, Chap. 7), for example, gives strong illustrative insights into entrepreneurial activities among UC San Diego's life science faculty. Likewise, there are numerous accounts of the close interactions between Stanford University and the computer and internet industry in the California Silicon Valley (Kenney 2000). It is obvious that here, the differences between university research and industrial application become blurred. Complex interactions and hybrid roles substitute the traditional linear and clear-cut innovation model and related role concepts of university research.

Conclusion and Future Directions

As it is seen in this very overview, the role of university research in innovation processes changed over time. Up to the 1970s, public university research was mainly seen as an indispensable resource for innovations in industry, without questioning the boundaries and cultural differences between both sectors. With the advent of technology transfer offices in the 1970s and 1980s, this concept was added by attempts at fostering a more active role for universities and university researchers in the transfer of knowledge and technology. Spearheaded again by the United States, in particular since the 1990s, hybrid organizational forms and the blurring of boundaries between university research and industrial application have been cherished both in theory and practice. However, doubts remain concerning the viability of conceptualizing universities and university researchers as economic actors. On the one hand, comparative analysis has shown that such concepts easily diffuse among policymakers, while their effectiveness is bound to particular circumstances which can hardly be found in settings that are different from the Silicon Valley or the San Diego biotechnology cluster. Casper (2007), for example, comes to a highly skeptical conclusion in his analysis of attempts at imitating these success stories in Europe. Furthermore, the intensification of close ties between university research and industrial application is not without serious concerns. Critics warn of the perils of "academic capitalism" (Slaugther and Leslie 1997; Slaughter and Rhoades 2004). Innovation systems are in need of a strong public research base which stands in contrast to the direct appropriation of research results through commercial activities. Likewise, the inherent uncertainties of academic research require an organization of work which is different from industrial application. Therefore, the long-term effects of current trends in university-industry relations have to be closely monitored by innovation researchers. In addition to this, further research on universities and innovation should focus in particular on two issues that have been widely neglected so far in the research presented above.

On the one hand, the intimate link between technological and social innovations should be further explored. The overwhelming majority of contributions in the field exclusively deals with technological innovations and the role universities play therein. Early insights by Smith, Marx, and Schumpeter on the mutual dependencies between technological and social change are mostly left out of sight. The examples are also manifold with regard to university research and innovation. The research laboratory as protected space where researchers could work and experiment without immediate economic or moral pressures is certainly a social innovation. Beginning at German universities in the mid-nineteenth century, this innovation rapidly diffused into industry as industrial laboratories were modeled accordingly and soon into other industrial countries. Though often forgotten, there is no doubt that the research laboratory as a new organizational form was responsible for many technological innovations that are so familiar to us. Likewise, one might argue that many technological innovations that are currently at the forefront of attention could only be fully understood if their related social innovations are also taken into account. One might think, for example, of open source software development where new and non-appropriatory forms of knowledge generation and sharing are developed which transcend traditional rules of the innovation process. Furthermore, if one broadens the agenda by also including social innovations, the contributions of many more academic disciplines and fields become visible as compared to technological innovations, where relevant university research stems from the natural sciences and engineering. Academic researchers, however, also contribute to social innovation processes by the participation in and the evaluation of new social arrangements, especially in local and regional settings. A second limitation of current research on universities and innovation is the overly strong focus on the research function of universities. Through this, mainly research-intense universities come into sight, and the contribution of universities by teaching and education is downplayed. Skills and competencies

embodied in individuals educated and trained at universities are of paramount importance for fully understanding the role of universities in larger innovation processes. Such a focus would allow to include also less research-intense universities and a broader array of higher education institutions in current research on universities and innovation, and a richer picture of the multiplicity and heterogeneity of universities' contributions to innovation might emerge.

Cross-References

- ▶ Academic Entrepreneur, Academic Entrepreneurship
- ▶ Academic Entrepreneurship
- ▶ Higher Education and Innovation
- ▶ National Innovation Systems (NIS)
- ▶ Social Innovation

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Unveil

- ▶ Invention Versus Discovery

User Innovators

- ▶ Entrepreneurship in Creative Economy

Using Movement, Music, and Humor - Creative Approaches to Enhance Student Engagement

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Synonyms

Creative music education; Interest and creativity

Key Concepts and Definition of Terms

Student Engagement

The phrase "student engagement" has come to describe "how *involved* or *interested* students appear to be in their learning and how *connected* they are to their classes, their institutions, and each other" (Axelson and Flick 2011, p. 38). Some teachers find that contemporary students display attitudes of simply wanting the information the teacher wants them to know for the test. Teachers and students may develop an unspoken pact whereby both parties get what they want; yet this seriously compromises real education. There is a continuum of what is meant by "student engagement" and an attendant range of benefits from capturing attention to facilitating deep learning. Particularly in higher education, where there tends to be enlarged focus on the cognitive domain and decreased concentration on physical and emotional considerations, it is valuable to

include classroom approaches that begin with enhancing attention and move toward deepening learning.

Background: Attention and Discussion

The literatures on attention problems in lectures as well as patterns of discussions in groups support the merits of all the approaches suggested here. An additional basis for including movement, music, and humor in classroom settings emerges from our understanding of attention span in lectures. Various reports (e.g., Young et al. 2009) demonstrate that when listening to a lecture, attention drops precipitously after 10–30 min. Diverse teachers seek to combat attention problems with straight lecture by using discussion. Unfortunately, studies of student participation in these discussions found that in groups of five, the most engaged person contributes 43 %, but the least engaged member only contributes 7 %; in groups of eight, the least engaged five members contribute a mere 3–9 % (Gibbs 1992). One need only speculate slightly to imagine to how small an extent most members in a typically sized class will be engaged.

The challenges of attention and discussion may be overcome and the benefits of student engagement can be achieved by using many techniques and methods, including three advocated here: movement, music, and humor.

Approach 1: Movement

Due to these challenges of attention span, an excellent way to elevate energy and engagement is with physical movement. It is ideal when movement can be incorporated directly with the learning objectives of the day (see below), but short activities simply to shift attention and awaken the students is beneficial. Teachers can use their creativity to invent options that work best in their own contexts. Some examples include having all the students do some imaginary biking or hiking in their chairs. Or perhaps students can have a real or imaginary ball to pass around the room. It could be as basic as a simple "stand, stretch, and breathe" moment. Some instructors enjoy employing laughter exercises as they have the multiple benefits of mood enhancement, increased oxygen, and playful movement. In many situations, movement may facilitate learning, enhance class cohesion, offer an environment that promotes laughter and fun while engaging learners, and it can heighten students' interest in attending and participating in class. There are times when a teacher may notice either at the start of a class or during a session, that the group seems lethargic. (This happens frequently during mid-semester exam week.) By having students stand up and do some playful activities, it easily produces some laughs, increases the energy level, and gets the group more engaged in the learning that will follow.

An assortment of movements and activities can be essential in getting learning "into the body." The overall point is rather than speaking about a concept, students can live it. For example, instead of a discussion of rapport, students could work in pairs and do exercises that involve mirroring or a two-step. Other examples of using movement to teach bodily dispositions of leadership, flow and optimal performance, and how to embody humor have been elaborated elsewhere (Strean 2010).

Approach 2: Music

A second set of approaches to overcome attention challenges and to engage students involves the use of music. Music can humanize, personalize, and energize classrooms. Music may tap into students' interests and prompt positive feelings and associations. Music may assist in creating relevant and meaningful interactions between and among students. From a physiological viewpoint, there is mounting evidence that music can effectively stimulate highly pleasurable emotional responses (e.g., Krumhansl 1997; Rickard 2004). Other studies (such as those using techniques like neuroimaging) have supported those responses and shown improved functional and effective connectivity between regions of the brain related to reward and they offer insight into understanding why listening to music is such a gratifying and

enjoyable experience. Interestingly, music-induced emotional states have been connected to release of dopamine, the chemical that sends "feel good" signals to the rest of the body. Music communicates straight to our emotions and it allows us to connect with the core of our aliveness. Music circumvents the cognitive filters and works wonders in a variety of ways to enhance student engagement. In addition to setting a mood or increasing energy, a well-chosen music clip can help to reinforce a learning point.

Approach 3: Humor

Although learning is serious business, heaviness and negative emotions can impede successful pedagogy. In addition to fostering valuable lightness, humor builds the teacher-student connection (e.g., Berk 1998), and this connection is essential for learning, satisfaction, and retention. Research demonstrates that with humor, students learn better and remember more; and absorb information more quickly and retain it longer. Furthermore, humor can assist teaching by offering amusement, breaking up content, captivating attention, lightening the mood, increasing motivation, reducing monotony, and providing a mental break. Humor escalates students' enjoyment of learning, perceptions of how much they learned and positive feelings about the course and instructor. Humor-based teaching is distinctly more engaging and interesting for the students and incorporating humor into the classroom can have a positive effect on learning in higher education. Interested readers can find more information on both the benefits of laughter and humor and specific strategies to use humor in the classroom elsewhere (e.g., Berk 1998; Strean 2008).

One of the easiest ways to incorporate humor into one's classes is using one's self as the easy target. By poking fun at one's self, a teacher can decrease the distance between students and "the professor." By showing one's own humanity and foibles, educators can make it easier for students to relax and to take risks. Particularly at the beginning of activities that may engender some anxiety, such as when students are about to participate in a novel task, humor can be especially effective to reduce tension and to enhance learning and performance.

Theoretical Background and Open-Ended Issues

Somatics

Somatics provides a valuable way of considering our students and ourselves that informs and supports the use of movement, music, and humor in learning. Although the seriousness of this background is in stark contrast to humor, it provides an important rationale for why the particular approaches advocated here are valuable in enhancing engagement and learning. The term "somatics," comes from *soma* – the body in its wholeness. From a somatic perspective, we cannot distinguish the self from the body. The characteristics that constitute the self (emotions, actions, beliefs, interactions, perceptions, ethics, morals, and drive for dignity) all emerge from the physical form (Strozzi-Heckler 2007). Somatics rejects the notion that there is a disembodied, self-contained self that is separate from the life of one's body. Clearly these ideas depart drastically from pervasive Cartesian discourses that have dominated and also posited a determinable, objective reality disconnected from subjective experience (Strean and Strozzi-Heckler 2009). The loss of somatic knowing and the worldview derived from Descartes's dualism carries its own logical conclusion: Since I have no immediate contact with any of the actualities of my everyday life, I can be deceived about any of them.

Most of our understanding of the mind and rationality are based on metaphors that are not supported by cognitive science. Take, for example, the persistent idea that rational thought is dispassionate. We know this to be incorrect from studies in neuroscience. Those who cannot be emotionally engaged in their lives cannot reason appropriately about moral issues. The traditional Western conception of the person with disembodied reason and an objective world has to be supplanted by the conception of an embodied

person. Among the important implications for teaching and learning is the recognition of the centrality of emotion. All learning occurs in a mood and part of fostering student engagement includes attending to and managing the mood of the classroom.

Movement, music, and humor can reawaken our somatic awareness and assist fuller and deeper learning experiences.

Implications for Theory, Policy, and Practice

Early childhood educators seem to recognize readily the importance of supportive environments to foster effective learning. As we progress along the developmental spectrum of schooling, there appears to be a callousing and concomitant loss of consideration to the safety of the atmosphere, the importance of emotions, and the value of multisensory practice. In planning effective implementation of movement, music, and humor, educators can be reminded of these crucial and useful basics. A positive, enlivened, and active environment enhances both the experience and the outcomes of learning.

Conclusion and Future Directions

Increasing student engagement is serious business. Paradoxically, bringing some lightheartedness to the process tends to make us more effective. As we ponder and explore various methods to connect with and to engage our students, movement, music, and humor appear to be three valuable methods. As learning approaches and technologies continue to grow and change, the fundamental importance of human connection will remain central and may become progressively challenging to maintain. Attending to the core needs of students will improve engagement and learning.

Cross-References

- ▶ Creativity Training in Design Education
- ▶ Effects of Intuition, Positive Affect, and Training on Creative Problem Solving
- ▶ Intrinsic and Prosocial Motivations, Perspective Taking, and Creativity

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Utopian Socialism

- ▶ Entrepreneur in Utopian Thinking