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Review paper

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Improving teaching design of active physics learning by using potentially helpful knowledge from other science fields

Extended summary

Every day, contemporary global economy more and more depends on the applicable knowledge and sophisticated skills of learning the employees. Nevertheless, teaching Physics by lectures, in which basis there is "an active teacher who presents the contents of the course to his passive students", usually does not contribute to knowledge and skills, which the students need. Global effects of this kind of learning and teaching are seen in the following: term knowledge is bad, there is no higher level of contemplation, and skills of solving problems are wrongly interpreted as an algorithmic play based on formulas. According to the research in education, active Physics learning is better than passive learning because it offers students possibilities to learn and improve the mentioned knowledge and skills. The best way to learn physics is the way similar to scientific praxis of real physicians. In other words, this means that active physics learning jeans that students should observe explain and predict physical phenomena.

Active learning physics has been becoming more and more popular in the classroom recently, owing to the examples of the physics design based such as *Workshop physics* by Priscilla Laws, Peer *Instruction* by Eric Mazur, *Student-Cantered Active Learning Environment for University Physics* by Robert Beichner *Technology-Enhanced Active Learning* by John Belcher, *Investigative Science Learning Environment* by Eugenia Etkina and Alan van Huevelen.

Nevertheless, there are two insufficient studied problems concerning planning and implementing of active learning Physics which can lessen efficiency and lasting of the effects of learning. Nevertheless, many students who study physics know little or nothing about the (1) significance of skills at the market and (2) subtle complexity of the process of learning.

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Considering the circumstances, students are not motivated enough to change what they do as a routine, memorising way of learning physics, which had been previously formed and enlarged through the experience with lecture type of learning physics. Even when students try to be active and to focus on learning physics, they face many difficulties because of the complexity of human learning.

Possible solutions of these problems lie in possibilities for the students to be informed how significant are the skills of learning in economy based on knowledge and to show to them compressible essence of theory of human learning.

In this paper, we are reporting about the results of the documentary research of the significance of learning skills in economic and compatible literature, so certain arguments are given as well as citations which can be prepared and used, so that students can be convinced how necessary it is to be prepared for lifelong learning.

Considering the theoretical aspect of human learning, readers will find descriptions of phases and different resources necessary for self-regulating learning. Physics teachers should know about these phases and resources, so that they could design multiple possibilities for their students, for exercising and improving self-regulating leaning which can have positive effects on academia results.

In this paper, we are also suggesting an original four-phase model, which explicitly helps self-regulating learning, by the Internet and in the classroom. Each special task of learning which can be "solving physics problems", or "finding explanations for physical phenomenon", in the first phase in solving problems at home and sending explanations by email, set with difficulties or uncertainties. The second phase is group discussion of personal solutions and the result should be group solution or explanation. Group report is also sent to the teacher by email. The third phase is reading expert opinion or explanation, which a teacher puts on the Facebook of a closed group connected to the course. This sequence is completed by the phase of self-reflection in which students should describe and comprehend good points and difficulties of learning they passed through in the previous three phases. First preliminary results are briefly commented, which were obtained in different implementations of this designed process of self-regulated learning.

Key words: Self-regulated learning, knowledge-based economy, knowledge workers, active physics learning.

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References

- Argyris, C. (1991), Teaching smart people how to learn, *Harvard Business Review, 4*(2), 99 – 109.
- Beichner, R. (2008). The SCALE-UP Project: A student-centered, active learning environment for undergraduate programs. An invited white paper for the National Academy of Sciences.
- Bransford, J. D., Brown, A. L. & Cocking, R.R. (editors) (2001). *How People Learn. Brain, Mind, Experience, and School*. Expanded Edition. Washington, D.C.: National Academy Press.
- Bonwell, C. C. & Eison, J. A. (1991). *Active Learning. Creating Excitement in the Classroom*. Washington: The George Washington University
- Cooke, P. (2001). *Knowledge Economies: Clusters, Learning and Co-Operative Advantage*. London: Routledge.
- Corona, A, Sliško, J. & Planinsic, G. (2006). Rising freely bottle also demonstrates weightlessness. *Physics Education*, *41*(3), 8 – 9.
- Deslauriers, L., Schelew, E. & Wieman, C. (2011). Improved Learning in a Large-Enrollment Physics Class, *Science, 332*(6031), 862 - 864.
- Dori, Y. J., & Belcher, J. (2005). How does technology-enabled active learning affect undergraduate students' understanding of electromagnetism concepts?. *The Journal of the Learning Sciences*, *14*(2), 243-279.
- Drucker, P. F. (1999), Knowledge-worker productivity: The biggest challenge, *California Management Review*, *41*(2), 79–94.
- Drucker, P. F. (2005). Managing Oneself. *Harvard Business Review*, *83*(1) 100- 109.
- Dykstra, D. I., Boyle, C. F., & Monarch, I. A. (1992). Studying conceptual change in learning physics. *Science Education*, *76*(6), 615-652.
- Etkina, E., & Van Heuvelen, A. (2001). Investigative science learning environment. In *APS Forum on Education Newsletter* (pp. 12-14).
- Galili, I. (1996). Students' conceptual change in geometrical optics. *International Journal of Science Education*, *18*(7), 847-868.
- Graham, P. A. (editor). (2002). *Knowledge Economy and Postsecondary Education: Report of a Workshop*. Washington, DC: National Academic Press.
- Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses, *American Journal of Physics, 66*(1), 64–74.
- Harmin, M. (1994). *Inspiring Active Learning. A Handbook for Teachers*. Alexandria: Association for Supervion and Curriculum Development.
- Harvard Business Review (1998). *Harvard Business Review on Knowledge Management*. Harvard: Havard Business School Press.
- Heron, P. R. L. & Meltzer, D. E. (2005). The future of physics education research: Intellectual challenges and practical concerns, *American Journal of Physics*, *73*(5), 390–394.

- Hestenes, D., Wells, M., & Swackhamer, G. (1992). Force concept inventory. *The physics teacher, 30*(3), 141-158.
- Hyysalo, S. (2009). Learning for learning economy and social learning. *Research Policy*, *38*(5), 726-735.
- Jarvis, P. (editor) (2001). *The Age of Learning: Education and the Knowledge Society.* London: Taylor and Francis Group.
- Johnson, B. (2011). From user-producer relations to the learning economy. *Science and Public Policy*, *38*(9), 703-711.
- Kapur, M. (2012). Productive failure in learning the concept of variance. *Instructional Science, 40*(4), 651–672.
- Keeling, R. P. & Hersh, R. H. (2012). *We're Losing Our Minds. Rethinking American Higher Education*. New York: Palgrave Macmillan.
- Laws, P. W. (1996). *Workshop Physics Activity Guide Modules 1-4*, New York, NY: John Wiley and Sons.
- Laws, P.W. (1997). Millikan Lecture 1996: Promoting active learning based on physics education research in introductorz physics courses. *American Journal of Physics*, *65*(1), 14–21.
- Low, R., & Jin, P. (2012), Self-Regulated Learning In *Encyclopedia of the Sciences of Learning* (pp. 3015-3018), New York: Springer.
- Maier, M., & Simkins, S. (2012). Learning from physics education research: lessons for economics education, in Hoyt, G.M. & McGoldrick, K.M. (editors) (2012). *International Handbook on Teaching and Learning Economics*. Cheltenham, UK: Edward Edgar Publishing (pp. 384 – 392).
- Maloney, D. P., O'Kuma, T. L., Hieggelke, C. J., & Van Heuvelen, A. (2001). Surveying students' conceptual knowledge of electricity and magnetism. *American Journal of Physics*, *69*(S1), S12-S23.
- Mazur, E. (1997). *Peer Instruction: A User's Manual*. Upper Saddle River, NJ: Prentice Hall.
- McDermott, L. C. (1991). Millikan Lecture 1990: What we teach and what is learned - Closing the gap. *American Journal of Physics*, *59*(4), 301-315.
- McDermott, L. C. (1993). Guest Comment: How we teach and how students learn—A mismatch? *American Journal of Physics*, *61*(4), 295-298.
- McDermott, L. C. & Edward F. Redish, E. F. (1999). Resource Letter: PER-1: Physics Education Research, *American Journal of Physics*, 67(9), 755-767.
- Meltzer, D. E. & Thornton, R. K. (2012). Resource Letter ALIP–1: Active-Learning Instruction in Physics. *American Journal of Physics*, *80*(6), 478-496.
- Méndez Coca, D. & Slisko, J. (2013a). Software Socrative and smartphones as tools for implementation of basic processes of active physics learning in classroom: An initial feasibility study with prospective teachers, *European Journal of Physics Education*, *4*(2), 17–24.
- Méndez Coca, D. & Slisko, J. (2013b). The influence of active physics learning on reasoning skills of prospective elementary teachers: A short initial study with ISLE methodology, *Latin American Journal of Physics Education*, *7*(1), 3–9.

- Nonaka, I. & Takeuchi, H. (1995). *The Knowledge-Creating Company*. New York: Oxford University Press.
- Pintrich, P. R., Marx, R. W., & Boyle, R. A. (1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational research*, *63*(2), 167-199.
- Pintrich, P. R. (1995). Understanding self-regulated learning. *New directions for teaching and learning*, *1995*(63), 3-12.
- Prince, M. (2004). Does active learning work? A review of the research. *Journal of Engineering Education*, *93*(3), 223–231.
- Schell, J., Lukoff, B. & Mazur, E. (2013). Catalyzing Learner Engagement using Cutting-Edge Classroom Response Systems in Higher Education, u C. Wankel i P. Blessinger (editors) (2013). *Increasing Student Engagement and Retention Using Classroom Technologies: Classroom Response Systems and Mediated Discourse Technologies (Cutting-edge Technologies in Higher Education, Volume 6)*. Bingley, UK: Emerald Group Publishing Limited, pp. 233-261.
- Senge, P. (2012) *A Systems Approach to Tranformation in Education*. Conference at the Master Class and Forum — Denver Metro Chamber Leadership Foundation, November 14, 2012. Siler, S. A., Klahr, D. & Price, N. (2013). Investigating the mechanisms of learning from a constrained preparation for future learning activity. *Instructional Science, 41*(4), 191–216.
- Sliško, J. & Medina Hernandez, R. (2005). Uspjesi i teškoće jedne implementacije paradigme "aktivnog učenja" u sveučilišnoj fizici. *Metodicki ogledi* (Zagreb, Croatia), *12*(2), 79-94.
- Thacker, B. A. (2003). Recent advances in classroom physics. *Reports on Progress in Physics*, *66*(10), 1833-1864.
- Wagner, T. (2008). Rigor redefined. *Educational Leadership*, *66*(2), 20–25.
- White, R. & Gunstone, R. (1992). *Probing Understanding*. London and New York: The Falmer Press.
- Zimmerman, B. J. (1990), Self-regulated learning and academic achievement: An overview, *Educational psychologist*, *25*(1), 3-17.
- Zimmerman, B. J. (2002), Becoming a self-regulated learner: An overview, *Theory into practice*, *41*(2), 64-67.
- Zimmerman, B. J., & Schunk, D. H. (Editors), (2013), *Self-regulated learning and academic achievement: Theoretical perspectives*, New York: Routledge.