

Engineering habits in virtual worlds

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Why?

Distance education is increasing and needs new solutions to convey the main goals of engineering education: design and systems thinking. Massively multiplayer online games (MMOG) seem to provide an authentic and holistic possibility space to develop systemic thinking and interdisciplinary teamwork.

Can the applicability of MMOG design principles for engineering education be approved?

Quantitative research results (Steinkuehler & Duncan 2008)

Scientific habits of mind in virtual worlds

Quantitative research of Steinkuehler & Duncan (2008) shows scientific habits of mind in virtual worlds.

Systems & model based reasoning

Mathematical computation
Mathematical modeling
Model based reasoning
Model testing & prediction
Systems based reasoning
Understanding feedback

Scientific discourse practices

Alternative explanations of data
Build on others' ideas
References outside resources
Social knowledge construction
Use of data/evidence
Use of counter arguments

Results

The comparison of 'scientific habits of mind' to the skills demanded from engineers shows the similarities of both: habits and skills.

The application of the main skills of engineers (System design and problem-solving in interdisciplinary collaboration) are covered by empiric results of scientific habits of mind in virtual worlds

Literature research

A literature research delivered six skill classes in engineering (apart from subject-specific knowledge) emphasizing design and problem solving in interdisciplinary collaboration.

Engineering skills

Problem solving

Use techniques, skills and tools for engineering practice
Apply knowledge of science, mathematics and engineering
Utilize experimental, statistical and computational methods
Design and conduct experiments
Identify, formulate and solve engineering problems

Design (of systems)

Model based thinking
Design systems within realistic constraints
Create Models

Communication & collaboration

Cooperate interdisciplinary teamwork
Communicate effectively
Global collaboration

Self assessment & life-long learning

Self assessment
Readiness for life-long learning

Integrative & interdisciplinary thinking

Interdisciplinary thinking
Integrative and global thinking

Management & administration

Leading skills
Change management
Management
Economics
Administration

Participation in the science fiction MMOG EVE Online showed distinct development and application of the remaining engineering skills.

Player habits in EVE Online

Calibration of skills, ship(s), equipment & purpose
Planning of short- and long-term skills according to personal goals and goals of the corporation
Learning the ropes of new fields of activity
Scheduling & realisation of training sessions
Splitting & distribution of problems

Assembly, organization & leadership of fleets according to different purposes
Management, administration & leadership of alliances, corporations, branches, groups, etc.
Scheduling & planning of member activity across different time zones
Administration of joint finances and resources
Scheduling &, management of work forces

Qualitative research Participation in a community of practice in the MMOG EVE Online.

Player habits in MMOGs are covering the complete general skill set demanded from engineers. A subject-specific context is missing to apply these skills and allow transfer to real situations.

Result

ABET 2009. Criteria for accrediting engineering programs 2008-2009. Baltimore.
Adams, J., Kaczmarczyk, S., Picton, P. & Diemian, P. 2010. Improving problem solving and encouraging creativity in engineering undergraduates in Proceedings of the International Conference on Engineering Education. Springer, p. 6.
Bréchet, Y.J.M. 2001. Interdisciplinary Training for Engineers in Educating the engineer for the 21st century. Dordrecht: Kluwer Academic Publishers, pp. 65-74.
Case, J.M. & Light, G. 2011. Emerging Methodologies in Engineering Education Research. Journal of Engineering Education, 100(1), pp.186-210.
Committee On The Engineer Of 2020, Phase I, Committee On Engineering Education, N.A.O.E. 2005. Educating the Engineer of 2020: Adapting Engineering Education to the New Century. Washington: The National Academies Press.
Davies, A., Fidler, D. & Gorbis, M. 2011. Future Work Skills. Palo Alto, CA.
Davis, D.C., Davis, I.T. & Beyerlein, S.W. 2005. Development and use of an engineer profile in Engineering Education Annual Conference. American Society for Engineering Education.
Dym, C.L., Agogino, A.M., Eris, O., Frey, D.D., et al. 2005. Engineering design thinking, teaching, and learning. Journal of Engineering Education, 94(1), pp.103-120.
Esposito, E. & Sigler, E. 2001. Acquiring the Tools to become a successful Engineer in the 21st Century. Aptitudes and Attitudes in D. Weichert et al. eds., Educating the engineer for the 21st century. Kluwer Academic, pp. 221-228.
Felder, R.M. 2002. Learning and teaching styles in engineering education. Journal of Engineering Education, 78(7), pp.674-681.
Hedberg, T. 2001. The Role of the global Engineer in Educating the engineer for the 21st century. Dordrecht: Kluwer Academic Publishers.
Kurstedt, P. 2001. An American Viewpoint on Engineering Education in Dieter Weichert et al. eds., Educating the engineer for the 21st century. Kluwer Academic, pp. 23-25.
Lehmann, E. & Miller, J. 2004. Stellungnahme zur Weiterentwicklung der Ingenieurausbildung in Deutschland. Düsseldorf.
Redish, E.F. & Smith, K.A. 2008. Looking Beyond Content: Skill Development for Engineers. Journal of Engineering, 97, pp.295-307.
Reuber, M. & Klocke, F. 2001. New Demands on Engineers in Educating the engineer for the 21st century. Dordrecht: Kluwer Academic Publishers, pp. 29-43.
Rugarcia, A., Felder, R.M., Woods, D.R. & Stice, J.E. 2000. The future of engineering education - A vision for a new century. Chemical Engineering Education, 34(1), pp.18-25.
Shuman, L.J., Besterfield-Sacre, M. & McCourt, J. 2005. The ABET Professional Skills? Can They Be Taught? Can They Be Assessed? Journal of Engineering Education, 94(1), pp.41-55.
Steinkuehler, C.A. & Duncan, S. 2008. Scientific Habits of Mind in Virtual Worlds. Journal of Science Education and Technology, 17(6), pp.530-543.
Stevens, R., O'Connor, K., Garrison, L., Joczus, A., et al. 2008. Becoming an engineer: Toward a three dimensional view of engineering learning. Journal of Engineering Education, 97(3), pp.355-368.
Stojcevski, A. 2008. Learning to Solve Design Problems? in Engineering Education in 36th Annual Conference, SEI: Quality Assessment, Employability and Innovation, Aalborg, Denmark.
Weichert, D. 2001. Educating the engineer for the 21st century (D. Weichert et al., eds.). Dordrecht: Kluwer.