

Chapter 20

Integrating Motivational Techniques into Learning Management Systems

Sabine Graf, Philippe Lachance and Biswajeet Mishra

Abstract Motivation is a key factor in education. However, learning systems typically do not directly consider motivational aspects to increase students' motivation. While there are a few systems that tapped into this area, they use either one motivational technique that can be applied in different settings or multiple motivational techniques that are then bound to a specific setting (e.g. a specific course/topic). In this paper, we propose the design, implementation and verification of four motivational techniques as well as a tracking mechanism to gather information on how students use the respective techniques. These techniques are system independent and content independent, and can therefore be used in any learning system and for any course. The motivational techniques were integrated into Moodle and verified through case studies. By integrating motivational techniques into learning systems, students can benefit from increased motivation, which again can have a positive impact on their overall performance.

Keywords Motivation · Motivational techniques · Learning management systems

20.1 Introduction

Motivation is a very important factor in education as it is the reason why learners engage in certain behaviour [1, 2]. A lot of research has been done on motivation in education, and several theories and models have been proposed that suggest how

S. Graf (✉) · P. Lachance
School of Computing and Informations Systems, Athabasca University,
Edmonton, Canada
e-mail: sabineg@athabascau.ca

P. Lachance
e-mail: phil.lachance@innovapost.com

B. Mishra
Birla Institute of Technology and Science Pilani, Pilani, India
e-mail: biswajeetmi91@gmail.com

© Springer Science+Business Media Singapore 2016
Y. Li et al. (eds.), *State-of-the-Art and Future Directions of Smart Learning*,
Lecture Notes in Educational Technology, DOI 10.1007/978-981-287-868-7_20

173

learners can be motivated and accordingly how courses should be designed and taught in order to motivate learners. Most of these guidelines focus on the preparation of learning materials, the presentation of topics and the teaching style used in lectures, mainly in face-to-face settings. While these are all important ways of increasing students' motivation, with the growing popularity of online learning, an additional opportunity arises for increasing students' motivation. Online systems such as learning management systems such as Moodle [3], Blackboard [4] and Sakai [5] are more and more used, either in completely online settings or in blended settings where students have face-to-face classes and use online learning. While these systems currently do not directly consider motivational aspects, they have the capacity to provide students with motivational techniques in order to increase their motivation and therefore their learning.

In our previous work [6], we identified eleven motivational techniques that were considered as most suitable to integrate into learning systems. These techniques have been selected based on a comprehensive literature review and with respect to their capabilities to motivate learners. Each technique is based on sound motivational theories and models, and most of them have been successfully implemented in prototype systems to show their impact on motivation. In this set of techniques, we only considered techniques that are domain independent and content independent, which makes it possible to use these techniques in any learning system and course, without the need to rewrite or extend the content of a course.

In this paper, we propose the design, implementation and verification of four of these motivational techniques, together with a tracking mechanism that allows gathering data about how motivational techniques are used. The motivational techniques have been designed in a system-independent way and were then implemented as a block for the learning management system Moodle. The proposed motivational techniques can benefit learners by providing them visualizations about their progress in the course and their pace compared to other learners, empowering learners to see their exact position in the course in terms of their progress, providing them with rankings to see how they perform in comparison with other learners and acknowledging achievements with awards to recognize hard work and engagement in the course.

The remainder of the paper is structured as follows. The next section discusses background on motivation in education and related works. Section 20.3 introduces the four motivational techniques and the tracking mechanism. Section 20.4 presents case studies to demonstrate how the motivational techniques work. Section 20.5 concludes the paper.

20.2 Background and Related Work

Motivation is based on different factors such as personal beliefs, feelings and/or preferences, and influences every behaviour someone engages in. In the context of education, motivation is important for learning as it can direct students' behaviour towards achieving a certain goal, increase a student's willingness to put more effort

towards achieving a goal, increase student's energy and persistence towards achieving a goal and as a consequence, lead to improved student performance where students achieve their learning goals [7].

Several motivational theories and models exist, aiming at explaining why people/learners are motivated and how to increase their motivation. One of the main motivational models in education is Keller's ARCS model [8], which is used to design motivational strategies into instructional materials to improve the motivational appeal. The ARCS model consists of four conceptual categories (attention, relevance, confidence and satisfaction) which are conditions that need to be met for people to become and remain motivated. The attention category includes perceptual and inquiry arousal. The relevance category includes goal orientation, motive matching and familiarity. The confidence category includes learning requirements, success opportunities and personal control. The satisfaction category includes intrinsic reinforcement, extrinsic rewards and equity.

From such motivational theories and models, motivational techniques can be derived which are practical tools and mechanisms of increasing motivation. Such motivational techniques can be integrated into learning systems to increase motivation of learners. There exist a few prototype systems that investigated the use of motivational techniques. For example, Huett et al. [9] found in an experiment that ARCS-based e-mail communications can lead to an increase in motivation, higher retention rate and a lower failure rate than the control group who did not receive such e-mails. Code et al. [10] developed a goal setting kit (GSK) that allows students to set and manage their goals in an e-learning course. Comtella [11] is a file and bookmark sharing system that includes motivational techniques such as hierarchical memberships, rewards, top users, best papers of week list, personalized messages and ratings, as well as rewards active users with better quality of service. Another system that uses motivational techniques is iHelp. iHelp [12] is an intelligent helpdesk system used in courses, where helpes pay and the helpers earn system credits redeemable for prizes at the end of the term. The system includes motivational techniques such as emoticons, a top helper list and an animated avatar.

While the examples above show that motivational techniques are already used to help online learners to increase their motivation, it can also be seen that these systems are either using multiple motivational technique but are then very domain dependent or use only one technique in a generic setting. Our research is different as we propose the use of multiple motivational techniques in a generic setting, so that learners can benefit from multiple techniques and these techniques can be used in different learning systems and courses.

20.3 Proposed Motivational Techniques

This section introduces four motivational techniques: progress timeline, progress annotation, ranking and awards, together with a tracking mechanism that allows gathering data from learners about how they use the respective motivational

techniques. In our previous work [6], these motivational techniques have been identified as particularly useful as they are domain independent and content independent and, therefore, can be integrated into any learning system and any course. The techniques have been designed in a generic way and were then implemented as a block for the learning management system Moodle. This *Motivational Techniques* block is visible on each Moodle page and provides overview information for each of the four motivational techniques, with options to navigate to the main interfaces of the respective motivational technique and to customize the motivational technique. In the following subsections, each technique is described in more detail.

20.3.1 Progress Timeline

The *progress timeline* technique helps learners in (1) monitoring their progress through a course based on milestones—a predefined collection of assignments, quizzes, exams or any other graded components of the course and (2) showing them their progress in relation to the average progress of the class in an anonymous format. This technique builds on the confidence and satisfaction categories of Keller’s ARCS model [8]. Through this technique, learners are provided with a tool which enables them to visualize the timeline of successfully completed as well as upcoming milestones. This in turn assists learners with their personal time management and strengthens their belief that they can master the learning tasks. Furthermore, the information on how a learner has progressed through the course in relation to his/her classmates can motivate him/her to work at the same or quicker pace.

Figure 20.1 depicts the interface of the *progress timeline* technique, integrated into Moodle. The predefined milestones are plotted on the x -axis, and time (in weeks) is shown along the y -axis. The chart consists of three lines: (1) the green line represents the ideal/recommended timeline, which is the timeline of the milestones as suggested or requested by the instructor (considering that while some online courses have strict deadlines, many courses allow students to submit such milestones at their own pace); (2) the black line represents the learner’s timeline in terms of his/her own progress in the course; and (3) the grey line represents the average timeline in terms of the average progress of all students enrolled in the course.

When setting up the *progress timeline* technique for a course, the teacher can select which learning objects should be considered as milestones and what the ideal day/week of completion would be for each milestone.

20.3.2 Progress Annotation

While the *progress timeline* technique mainly deals with providing information to the learner regarding the time in which graded course components should be ideally

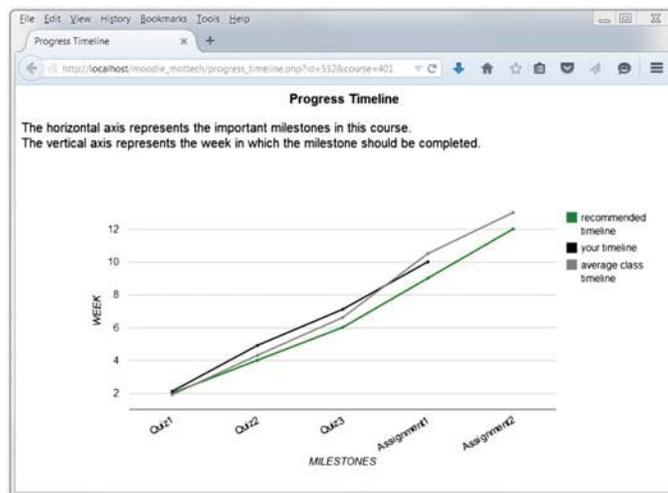


Fig. 20.1 Interface of the *progress timeline* technique

completed and helps in maintaining a good pace, the *progress annotation* technique helps the learner keep track of the status of the various learning objects in the course by tagging learning objects as completed, in progress or not started. This technique builds on the confidence and satisfaction categories of Keller's ARCS model [8]. It empowers learners by displaying their exact position in the course with respect to completed learning objects and can assist them with their time management.

The implementation of the *progress annotation* technique consists of two parts. First, the learners can tag each learning object in the course as completed (by clicking on the checkmark symbol), in progress (by clicking on the diamond symbol) or not started (which is selected by default but can be reselected by clicking on the X symbol). Second, the learners can access an overview page via a button in the *Motivational Techniques* Moodle block showing their progress distribution for the course. Figure 20.2 illustrates the functionality to tag learning objects, and Fig. 20.3 shows the overview chart based on the learner's selection of tags for learning objects.

When setting up the *progress annotation* technique for a course, the learning objects are automatically detected by the system during installation.

20.3.3 Ranking

The *ranking* technique is used to sort learners based on certain criteria. Learners can be ranked, for example, on their performance, the amount of time they spend online and milestones reached in the course. The *ranking* technique is used in other

Fig. 20.2 Progress annotations in a course

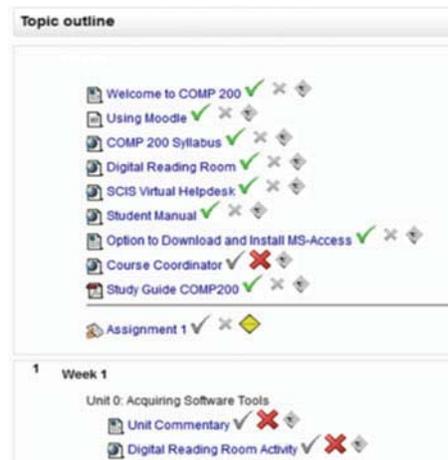
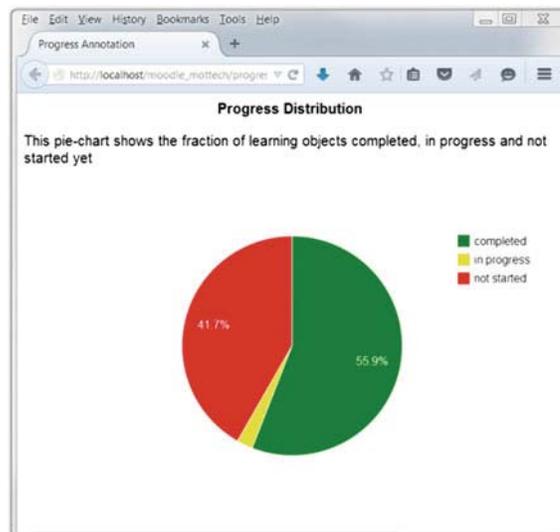


Fig. 20.3 Progress distribution



systems such as Comtella [13] which ranks learners based on the quality and quantity of their contributions and iHelp [12] which displays a top helper list. With the *ranking* technique, a learner is rewarded or satisfied by statistics that are displayed and allow the learner to compare themselves with other learners, which builds on the satisfaction category of Keller's ARCS model [8]. Learners can use the displayed information to try to continually improve.

For each learner, the top five rankings are displayed in the *Motivational Techniques* Moodle block with a link to the main menu for all rankings and a link for the student options. A cron process runs in the background to generate the

Fig. 20.4 Overall grades

| Rank | Name | Active | Grade |
|------|---------|--------|-------|
| 1 | Sally | x | 94.33 |
| 2 | Richard | x | 88 |
| 3 | Thomas | x | 86.2 |
| 4 | Jane | x | 71 |

rankings at a scheduled time. Fourteen different rankings have been implemented, together with an overview page that shows all ranks of a learner. These fourteen rankings show grades of assignments, grades of quizzes, overall grades, total number of awards achieved, overall time online, time online in current month, overall number of posts submitted, number of posts submitted in current month, overall post ratings, post ratings in current month, overall reading of all posts, reading of all posts in current month, amount of time it took to reach each milestone and pace to complete milestones.

Figure 20.4 shows a screenshot of a ranking page. The information displayed for each ranking is the rank achieved, the learner's name and the value being ranked on (e.g. grade and time spent). Learners can select to see active and inactive learners or only active learners to compare their results with. In rankings where data are collected over multiple months, learners can see the overall result and results for each month. The current learner is highlighted in yellow in the rankings. Furthermore, learners are able to customize whether they want their names shown or be anonymous.

When setting up the *ranking* technique for a course, available ranking categories are automatically detected by the system.

20.3.4 Awards

Learners are provided with an incentive and/or recognition with the *awards* technique. A learner can either achieve or not achieve an award, and awards can be based on a scale or levels. The *awards* technique is used in other systems such as Comtella [13] which awards active users with better quality of service and iHelp [12] where postings with the highest scores are awarded higher visibility. The

awards technique rewards a learner and therefore builds on the satisfaction category of Keller's ARCS model [8]. Learners can be motivated through this technique since they are provided recognition and a sense of accomplishment.

The top five awards are displayed in the *Motivational Techniques* Moodle block with a link to the main menu for the awards and a link for student options. A cron process runs in the background to generate the awards at a scheduled time. Twelve different award categories have been implemented, together with an overview page showing all achieved awards. These twelve categories provide awards related to grades of assignments, grades of quizzes, overall grades, completed course milestones within a time period, overall time online, time online in current month, overall number of posts submitted, number of posts submitted in current month, overall post ratings, post ratings in current month, overall reading of all posts and reading of all posts in current month. While these are similar categories as used for rankings, the two techniques aim at motivating learners in different ways. In the *ranking* technique, learners are shown a particular rank in relation to their classmates, allowing them to compare themselves to their classmates. The *awards* technique is solely depending on the individual learner's achievements in a course, independent of the achievements of their classmates. Accordingly, learners are motivated to reach certain thresholds (e.g. completing a course milestone within a certain period of time and achieving a certain grade) in order to get a bronze, silver or gold award.

Figure 20.5 shows the interface of one of the awards categories. The information displayed for each award category includes the learners' names and the awards achieved ordered by highest to lowest award achieved. Learners can select to see active and inactive learners or only active learners to compare their results with. For

Fig. 20.5 Overall number of posts submitted

Awards - Overall number of posts submitted

You are logged in as Sally (Logout)

Awards for overall number of posts submitted award with a breakdown by month.

Total is calculated with a weighting of Gold = 3, Silver = 2 and Bronze = 1.

[Awards Main Menu](#) [Show Active and Inactive Students](#)

| Name | Active | Total | June (current) | May | April |
|---------|--------|-------|----------------|--------|-------|
| Sally | x | 4 | Silver | Silver | |
| Jane | x | 2 | Bronze | Bronze | |
| Richard | x | 1 | Bronze | | |
| Thomas | x | 1 | Bronze | | |

awards where data are collected over multiple months, learners can see their awards in each month and a total weighted score summing up their awards for each month. The current learner is highlighted in yellow in the awards interfaces. Furthermore, learners are able to customize whether they want their names shown or be anonymous.

When setting up the *awards* technique, available awards categories are automatically detected by the system and teachers can customize parameters for the awards such as thresholds for awards and their weights.

20.3.5 Tracking Functionality for Motivational Techniques

In order to understand how students are actually using the different motivational techniques, tracking functionality has been designed and implemented that logs learners' behaviour and actions related to the motivational techniques, including which techniques and pages the learner visited and how long he/she visited these pages. Such information provides valuable insights into how often the techniques are used by different learners in different situations and, in combination with other data, can help to determine whether learners actually benefit from these motivational techniques.

To implement such tracking mechanism, each time a learner is using the motivational techniques (e.g. by visiting a ranking page and tagging a learning object), and a log entry is created in the Moodle database. This log entry consists of the following information: a timestamp, the learner's id, the course id and the visited page together with information on the motivational technique.

20.4 Case Studies Demonstrating the Motivational Techniques

In this section, we present a case study for each motivational technique to verify and illustrate how each motivational technique works.

To illustrate the *progress timeline* technique, let us consider a learner named Diana who is very close to the end of a course. Diana has already completed most of the milestones of the course, namely three quizzes and one assignment, and only has one assignment left to complete. While Diana can go through the course in her own pace, the instructor recommends completing Quiz 1 by the end of week 2, Quiz 2 by the end of week 4, Quiz 3 by the end of week 6, Assignment 1 by the end of week 9 and Assignment 2 by the end of week 12. Let us assume in this example that most students follow the respective recommendations, but there are some delays. Accordingly, on average, Quiz 1 is completed even shortly before week 2, Quiz 2 is completed after 4 weeks and 2 days, Quiz 3 is completed after 6 weeks and 4 days,

Assignment 1 is completed after 10 weeks and 3 days, and Assignment 2 is completed after 13 weeks. Let us also assume that Diana had a little delay for Quiz 1 and submitted it after 2 weeks and 1 day, Quiz 2 was submitted after 4 weeks and 6 days, Quiz 3 was submitted after 7 weeks and 1 day, Assignment 1 was submitted after 10 weeks, and Diana has not submitted Assignment 2 yet. Based on these assumptions, Diana would see the chart presented in Fig. 20.1. The chart shows that Diana took more time than recommended by the instructor for all so far submitted milestones, and while for Quiz 1, Quiz 2 and Quiz 3, she took more time than the average, and Diana did make up some time when submitting Assignment 1, which was submitted earlier than average.

To illustrate the *progress annotation* technique, let us consider another learner named Jon. Jon has used the *progress annotation* technique and tagged the learning objects that he has completed or is currently working on. Figure 20.2 shows a snapshot of the learning objects that he tagged. Overall, there are 127 learning objects in the course. Jon already completed 71 learning objects, and he is currently working on 3 learning objects in parallel, which include an assignment, a content page and a forum where he posted a question. The other 53 learning objects are not started yet. When Jon clicks on the ‘View Progress Distribution’ button in the *Motivational Techniques* Moodle block, he can see the diagram depicted in Fig. 20.3, showing his current progress distribution. In this diagram, it can be seen that Jon completed already 55.9 % of the learning objects, he is working on 2.4 % of the learning objects, and there are still 41.7 % of learning objects to complete.

To illustrate the *rankings* technique, let us consider another case. Let us assume a course where by April 1st, four students (Jane, Richard, Sally and Thomas) started. After two months, each student has completed some of the graded course components in the course (e.g. quizzes and assignments). Table 20.1 shows the grades achieved by the four students on completed gradable course components in the first two months. Based on these grades, the weighted average grade of all completed gradable course components is calculated. When Sally takes a look at the ranking for overall grades, she would see the interface depicted in Fig. 20.4.

To illustrate the *awards* technique, we look at the awards for the overall number of posts submitted and assume that Jane, Richard, Sally and Thomas are now in the

Table 20.1 Example of students’ grades on gradable course components

| Submission date | Gradable course component | Student | Weight | Grade (0–100) |
|-----------------|---------------------------|---------|--------|---------------|
| 20/04/2015 | Quiz 1 | Sally | 10 | 95 |
| 25/04/2015 | Quiz 1 | Richard | 10 | 91 |
| 26/04/2015 | Quiz 1 | Thomas | 10 | 79 |
| 30/04/2015 | Quiz 2 | Sally | 15 | 97 |
| 01/05/2015 | Quiz 1 | Jane | 10 | 71 |
| 10/05/2015 | Quiz 2 | Richard | 15 | 86 |
| 11/05/2015 | Quiz 2 | Thomas | 15 | 91 |
| 30/05/2015 | Quiz 3 | Sally | 20 | 92 |

Table 20.2 Example of students' postings to forums

| Date | Student | Messages posted |
|------------|---------|---|
| 05/06/2015 | Thomas | Re: difference between database types |
| 04/06/2015 | Jane | Re: difference between database types |
| 02/06/2015 | Richard | Difference between database types |
| 25/05/2015 | Thomas | Re: discussion about relational databases |
| 24/05/2015 | Sally | Re: discussion about relational databases |
| 23/05/2015 | Jane | Re: discussion about relational databases |
| 22/05/2015 | Sally | Re: discussion about relational databases |
| 18/05/2015 | Thomas | Re: discussion about relational databases |
| 16/05/2015 | Sally | Discussion about relational databases |
| 25/04/2015 | Richard | Re: question about Quiz 2 |
| 23/04/2015 | Sally | Re: question about Quiz 2 |
| 23/04/2015 | Jane | Re: question about Quiz 2 |
| 20/04/2015 | Sally | Question about Quiz 2 |
| 02/04/2015 | Jane | Re: introduction |
| 01/04/2015 | Richard | Re: introduction |
| 01/04/2015 | Sally | Introduction |

course for three months (April to June) and have had different forum posting activities, as shown in Table 20.2. Awards are configurable so that a teacher can decide what thresholds are used to determine the requirements on when an award is given to students. For example, some courses might require many posts, while other courses might not. By changing the settings, a teacher can tailor the motivational technique to the course. Let us assume that in this case, we go with the default thresholds, which are five postings per month for a gold award, three postings per month for a silver award and two postings per month for a bronze award. To calculate the awards, the number of posts a learner has written in each month is considered and then, the awards given to students are displayed. Furthermore, a total score is calculated that represents the learners' overall number of points achieved for each award based on the weight of the awards, which can again be configured by teachers. Given the actions in Table 20.2, Sally would see the awards page as depicted in Fig. 20.5.

20.5 Conclusions

This paper introduced the design, implementation and verification of four motivational techniques: progress timeline, progress annotations, rankings and awards, as well as a tracking mechanism to log students' behaviour related to these techniques. The motivational techniques are designed to be used in different courses and learning systems; however, they were implemented as a block in Moodle.

By integrating multiple motivational techniques into learning systems, students can select between different techniques that can increase their motivation at different stages and in different situations in the course. Furthermore, by tracking how students use these motivational techniques, we can get valuable insights into when and for whom each motivational technique is most valuable in terms of motivating students most. Such information is the basis for creating an adaptive system that can provide students with the right motivational technique at the right time based on the students' individual characteristics and their current situation in the course.

Future work will deal with the use of the motivational techniques and the gathering of data to assess which students use which techniques in which situations. Based on this information, an adaptive mechanism will be developed that suggests motivational technique to learners based on their characteristics and situations in the course.

Acknowledgment The authors acknowledge the support of Mitacs, NSERC, and Athabasca University.

References

1. Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist*, 41(10), 1040–1048.
2. Dickinson, L. (1995). Autonomy and motivation: A literature review. *System*, 23(2), 165–174.
3. Moodle. <http://www.moodle.org>. Accessed April 27, 2015.
4. Blackboard. <http://www.blackboard.com>. Accessed April 27, 2015.
5. Sakai. <https://www.sakaiproject.org/>. Accessed April 27, 2015.
6. Baumstark, K., & Graf, S. (2014). A framework for integrating motivational techniques in technology enhanced learning. In *Post-Proceedings of the International Workshop on Social and Personal Computing for Web-supported Learning Communities (SPeL 2011)*, LNSC (Vol. 7697, pp. 150–160). Berlin: Springer.
7. Ormrod, J. (2007). *Educational psychology: Developing learners*. Columbus: Prentice Hall.
8. Keller, J. M. (1987). Development and use of the ARCS model of motivational design. *Journal of Instructional Development*, 10(3), 2–10.
9. Huett, J. B., Kalinowski, K. E., Moller, L., & Huett, K. C. (2008). Improving the motivation and retention of online students through the use of ARCS-based e-mails. *American Journal of Distance Education*, 22(3), 159–176.
10. Code, J. R., MacAllister, K., Gress, C. L. Z., & Nesbit, J. C. (2006). Self-regulated learning, motivation and goal theory: Implications for instructional design and e-learning. In *Proceedings of the International Conference on Advanced Learning Technologies* (pp. 872–874). IEEE.
11. Cheng, R., & Vassileva, J. (2006). Design and evaluation of an adaptive incentive mechanism for sustained educational online communities. *User Modeling and User-Adapted Interaction*, 16(2/3), 321–348.
12. Vassileva, J. (2002). Motivating participation in virtual communities. In *Proceedings of the International Conference of Women Engineers and Scientists*, Ottawa, Canada.
13. Vassileva, J. (2014). Harnessing P2P power in the classroom. In *Proceedings of the International Conference on Intelligent Tutoring Systems* (pp. 305–314). Berlin: Springer.