

A Serious Game for Students to Acquire Productivity Habits

Raateland, Wouter; Chronas, Konstantinos ; Wissel, Tim; Bruyn, Tim; Konuralp, Bertan ; Bueno , Mijal; Salamon, Nestor Z.; Bidarra, R.

DOI

[10.1007/978-3-030-63464-3_32](https://doi.org/10.1007/978-3-030-63464-3_32)

Publication date

2020

Document Version

Final published version

Published in

Games and Learning Alliance

Citation (APA)

Raateland, W., Chronas, K., Wissel, T., Bruyn, T., Konuralp, B., Bueno, M., Salamon, N. Z., & Bidarra, R. (2020). A Serious Game for Students to Acquire Productivity Habits. In I. Marfisi-Schottman, F. Bellotti, L. Hamon, & R. Klemke (Eds.), *Games and Learning Alliance : 9th International Conference, GALA 2020, Proceedings* (pp. 335-346). (Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics); Vol. 12517). Springer. https://doi.org/10.1007/978-3-030-63464-3_32

Important note

To cite this publication, please use the final published version (if applicable). Please check the document version above.

Copyright

Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy

Please contact us and provide details if you believe this document breaches copyrights. We will remove access to the work immediately and investigate your claim.

Green Open Access added to TU Delft Institutional Repository

'You share, we take care!' - Taverne project

<https://www.openaccess.nl/en/you-share-we-take-care>

Otherwise as indicated in the copyright section: the publisher is the copyright holder of this work and the author uses the Dutch legislation to make this work public.



A Serious Game for Students to Acquire Productivity Habits

Wouter Raateland, Konstantinos Chronas, Tim Wissel, Tim Bruyn,
Bertan Konuralp, Mijael Bueno, Nestor Z. Salamon,
and Rafael Bidarra^(✉)

Delft University of Technology, Delft, The Netherlands
R.Bidarra@tudelft.nl

Abstract. In recent years there has been an increasing shift from traditional work to knowledge work. Students are not always well prepared for such a work mode and struggle with time and energy management, leading to stress and long unhealthy study sessions. There are many applications aimed at developing productivity habits. A few of them are somewhat gamified, although they are especially focused on real-world to-do lists, lacking a strong narrative and appeal, especially to students. We present the serious game *BusyBusy*, specifically designed for college students. The game revolves around the *capture* and *reflection* steps of David Allen's *Getting Things Done* methodology. By simulating aspects of student life, *BusyBusy* facilitates students to practice capturing action-related thoughts in their real life and reflect upon study activity choices in an entertaining and engaging environment.

Keywords: Serious games · Getting Things Done · Habit building · Personal productivity · Mobile games

1 Introduction

The rapid growth of globalization and the evolution of technology has created an overwhelming amount of information that people have to adapt to. One part of society that struggles to adapt are academic students, who face the challenge of balancing their academic goals and other activities in their life. The current education system falls short in preparing students for knowledge work [16]. Hence, an increase in anxiety and procrastination among students is being noticed [7, 13]. Traditionally, procrastination is defined as the undesirable behavior of irrationally delaying a course of intended action, with the understanding that it may result in not ideal outcomes. Nonetheless, researchers found out that 50% of students procrastinate consistently at university [18]. Students who often procrastinate generally encounter less stress at the beginning of a semester, more stress later on, and generally suffer more often from anxiety than the ones who do not [20].

A common reason for stress is the overload of information and possible activities. As the amount of time is finite, this overload means a number of potentially

important items can no longer be processed. This creates a lack of control that results in stress [9].

This paper presents *BusyBusy*, a serious game for students to acquire productivity habits that gamifies the *capture* step of the *Getting Things Done* (GTD) methodology. The game is lighthearted simulation of student life in the style of *Dumb Ways to Die*¹. Its design focuses on learning how to clear up daily thoughts, when struggling with stress and procrastination. We incorporate a constructivist learning approach [6] to train students to balance different responsibilities while keeping their minds clear. This is achieved by the player performing a series of activities in the form of mini-games, while dealing with thoughts that pop up on the screen, resembling the distracting thoughts occurring to a student.

2 Related Work

We revisit stress-reducing research, applications and games to improve productivity, in the form of task managers or GTD guides. While students use different types of task managers and to-do lists, either gamified or not, these are not focused on integrating the daily student routine.

Stress Reduction and Prevention. Several stress reducing methods focus on reducing stress through physical exercise [12] and yoga or meditation [10]. To prevent stress from occurring, a currently popular methodology that helps students is called *Getting Things Done*®² (GTD) and was proposed by David Allen in 2001 as 'the art of stress-free productivity' [1]. Allen outlined a five-step method for reducing stress while staying on top of an increasingly complex world: “We **(1) capture** things that command our attention; **(2) clarify** what they mean and what to do with them; and **(3) organize** the results, on which we **(4) reflect** as options for what we choose to **(5) engage** with”. According to research, GTD can mitigate feelings of stress, anxiety and information overload that are often experienced during knowledge work by restoring a sense of control [9]. It does so by outsourcing thoughts to an external memory [3]. Furthermore, by providing focus and structure, GTD reduces switching of mental context, which costs time and energy [4].

GTD-related Task Managers. Structuring activities according to the GTD methodology can be done with a task manager. In the book *Getting Things Done* [1], seven different lists, or destinations for *stuff*, are mentioned: Next Actions, Waiting for, Calendar, Someday/Maybe, Trash, Archive and Projects list. In addition, there should be an Inbox, that functions as a bucket to quickly capture whatever needs later clarification. Many task managers give users the option to define their own lists or come with predefined lists for GTD. Examples

¹ <http://www.dumbwaystodie.com/>.

² <https://gettingthingsdone.com/>.

of this are nTask [15] and Nirvana HQ [14]. GTD-related task managers help a user to structure their to-do list while still relying on the intrinsic motivation of the user. Nonetheless, they assume that the user is already familiar with the GTD methodology.

Productivity Related Games. Recently, incorporating gamification in task managers has received significant attention. Games such as Habitica [8], Super-Better [19] and EpicWin [17] are gamified task managers which include elements such as completing quests and role-playing for engagement, and experience points and leveling up as a reward system. However, similar to the GTD-related task managers, these games target users who are already motivated to improve their productivity habits, rather than users who do not consider changing their daily routine of habits.

Theories of Learning. Effective knowledge transfer with stress reduction methods has been the target of frameworks such as the constructivism theory of learning. Constructivism equates learning with creating meaning from experience [6]. Students learn by fitting new information together with previous knowledge and current beliefs and attitudes [2]. By perceiving new experiences, students update their mental model to reflect the new information and use it to construct their interpretation of reality [5]. Hence, it directly proposes an effective way of creating habits.

BusyBusy applies Constructivism learning theory by simulating a scenario that demonstrates the use of GTD. We create an environment where the player experiences a loss of control and can regain control by applying the *capture* and *reflection* steps of GTD. *BusyBusy* advises the players to bring order to the learning process by sorting their thoughts and gaining experience with the mini-games in a virtual experience, without confronting the player with real life tasks.

3 Game Design

The goal of the game is to help students to cope with stress by acquiring the *capturing* habit. To satisfy this goal, the game should: (i) be relatable to the player, (ii) strike a balance between fun and learning, (iii) let the player experience the *capturing* habit, and (iv) be played for consecutive days while *reflecting* about the learned behavior.

To create a game that is relatable to the player, we developed a simulation game wherein the player takes the role of a virtual student. Just like a real student, the virtual student needs to complete courses, keep their room clean, stay healthy, and be entertained. To successfully achieve this, the virtual student needs to balance studying with other activities. The game strikes a balance between fun and learning by visualizing the activities that the student has to do as fast-paced mini-games. During these mini-games the player experiences the *capturing* habit: thoughts related to other must-do activities appear on the screen and the player has to manage them.

The game includes different courses that last multiple game-days. Additionally, to stimulate students to come back daily to the game, we included a streak system rewarding the player for playing consecutive days.

3.1 Game Activities

There are currently 5 activities in the game that the player has to complete: doing homework, working out, cleaning room, socializing and playing games. The activities are grouped into three categories and presented in the form of mini-games. The productivity category encapsulates any productive activity, represented in *BusyBusy* with working out. The organizational category consists of activities that influence the virtual student's room/environment. Finally, the entertainment category includes social and fun activities. Learning efficiency and course progress is affected by a balance of the studying activity and all of these categories.

3.2 Thoughts in the Game

During the mini-games, thought bubbles pop up, related to other activities, representing the thoughts of the virtual student. While floating around the screen, these thought bubbles distract the player from playing the mini-games. However, they also let the player experience how capturing thoughts affects the performance of their daily activities, in a direct and visual way: the player can act on each thought bubble by either capturing it, i.e. dragging it to the collection box, or by trashing it, i.e. dragging it to the trash bin. When more than 5 thoughts are floating around simultaneously, the oldest thoughts get forgotten. If at the end of a game-day, the player has properly dealt with enough thoughts (i.e. there are at most 2 left floating), they will be positively rewarded on each score; otherwise, the player will be penalized on the scores for each forgotten thought. This mechanism encourages the player to perform the capturing habit inside the game. More importantly, the captured thought bubbles control the game cycle: the player's next activity is namely determined by the captured thoughts during the current activity.

3.3 Game Cycle

In *BusyBusy*, virtual student life takes place turn-based, in game-days. Each game-day consists of one to three mini-games. Figure 1 illustrates the complete game flow. Each game-day takes about 1–2 min, specially designed so a student can do a short game-play session without the burden of having yet another time consuming task. On the first day, after a short tutorial, a new course starts and the player is left on the main menu (the student room). From here, the player can start a new game-day with its mini-games. The game-day ends when no thoughts are captured during a mini-game or when 3 mini-games have been played. At the end of the game-day, the player is presented with the score screen. This is

repeated till the end of the current course, when the player receives feedback on their grades. Thereafter, a new course can be started with zero scores and progress – hence, the game cycle restarts.

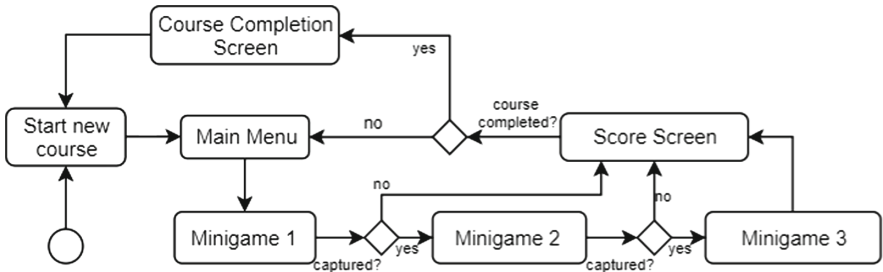


Fig. 1. The game loop of *BusyBusy*.

3.4 Scoring

During the game, we track four scores. The primary score is the virtual student’s progress on their current course. Course progress is reset each time a new course is started, and has to be sufficiently high when the course ends. The other three scores relate to activities a student has to perform in their life: productivity, organization and entertainment, and start at 50%.

The effect of each mini-game on their respective scores is presented in Table 1. During the game, the scores are displayed in the main menu and on the scoring screen. At the end of a game-day, the player score is computed based on the played activities. By being shown their scores, players are also encouraged to *reflect* on their progress.

When a player plays at least one game-day on an actual day, their streak is incremented; otherwise, it is reset to zero. For each streak, the player will gain a multiplier on progress they get for one score.

Table 1. The mini-games and its effects on each score on the virtual student life.

Score	Activity	Mini-game	Amount
(P)roductivity	Working out	Jumping rope (timing)	+10%
(O)rganization	Cleaning room	Navigation game	+10%
(E)ntertainment	Social activities	Block-breaker	+10%
	Gaming	Pinball	+10%
Study progress	Studying	Memory	1 + (P) + (O) + (E)

3.5 Mini-Game Design

Each activity in *BusyBusy* is relatable to student life domains: study, socialize, clean, workout and have fun. The player engages in these domains by playing the corresponding mini-games, having to balance their activities in the game.

Study. The study mini-game is a memory quiz where the player has to select the correct answer within the time limit. In the game, the player experiences stress from the toughness of trying to remember all the shapes and their respective colors while also dealing with the floating thought bubbles. This memory game was chosen because it is reminiscent of studying, remembering concepts of a course and testing yourself by answering questions. The mini-game is shown in Fig. 2a.

Workout. The workout mini-game focuses on the reflexes of the player. The player has to tap on the screen at the right time to make the virtual student jump a rope within the time limit. Jumping rope is an easy and effective cardio workout and like in the game, depends on the reflexes of a person to time and jump at the downswing of the rope. The mini-game is shown in Fig. 2b.

Socialize. The socialize mini-game is a block-breaker variant where the player controls a paddle and has to hit beer glasses with a ball, also within the time limit. This game is a fun experience, representing the player going out with friends, as one of the multiple social interactions students like to have. The mini-game is shown in Fig. 2c.

Fun. The fun mini-game is a classic pinball game where the player has to touch all targets with the ball. Many students play games to have fun, and pinball represents a relaxing arcade game. The mini-game is shown in Fig. 2d.

Cleaning. In the cleaning mini-game, the player has to clear objects around the room by controlling a hose with a gamepad during the allocated time. This mini-game is a straightforward representation of the domain, vacuuming your room to clean it. Furthermore, the controls and the feel of the game correlate well with the idea of vacuuming a room. The mini-game is shown in Fig. 2e. All mini-games are integrated in one web-based application³, meant to be played on mobile devices, with all player data being stored locally.

³ Freely available at <https://busy-busy.netlify.com/>.

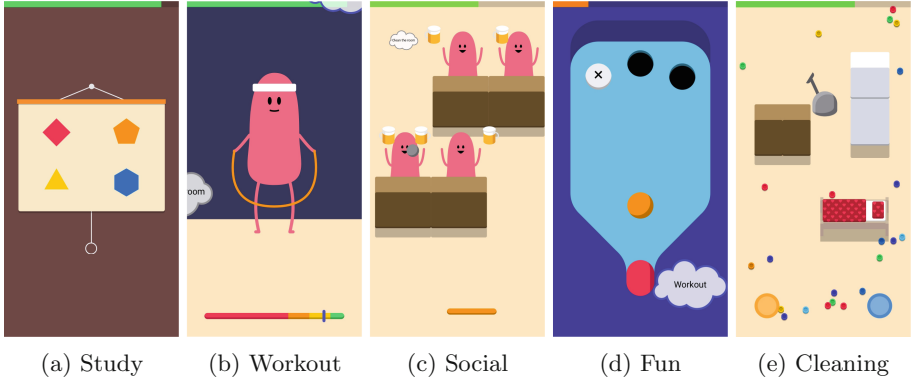


Fig. 2. The mini-games in *BusyBusy*.

4 Evaluation

We conducted two studies to evaluate *BusyBusy*: the first considers the effects of playing *BusyBusy* only once, while the second considers the effects of playing it for a longer period.

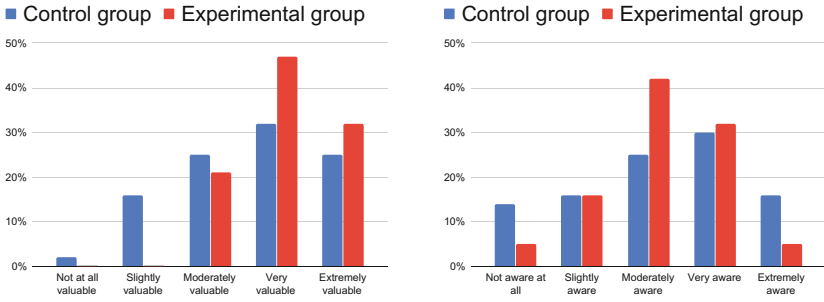
4.1 Study 1

This study considered the effect of playing *BusyBusy* only once. Our hypothesis was that participants who play *BusyBusy* will be more aware of the value of capturing thoughts than the participants who only answered the survey.

Method. The study was conducted as a double blind trial, with two groups: the experimental group first played *BusyBusy* for five minutes on their phone and then took the survey in Appendix A; the control group only took the survey.

Results. Figure 3 shows the responses of both the control group and the experimental group for two survey questions. Table 2 presents a statistical analysis of the responses. Figure 3a shows that the experimental group considers the value of capturing thoughts very valuable or extremely valuable more often than the control group, with 79% versus 56%. With a P-value of 0.035, this difference is statistically significant. Figure 3b shows that the control group actually found themselves less often unaware of the value of capturing thoughts. However, with a P-value of 0.945, no statistical difference between the groups is found.

Discussion. The statistically significant difference in the respondents answers to Q4 shows that *BusyBusy* indeed makes players aware of the value of capturing thoughts after playing it once. Q5 could have strengthened this evidence, but its answers fail to show any significant difference between the groups.



(a) Responses on Q4: “How valuable do you think it is to capture your thoughts outside of your head?” (b) Responses on Q5: “How aware are you of the value of capturing thoughts outside of your head?”

Fig. 3. Responses on survey questions for study 1.

4.2 Study 2

This study considered the effect of playing *BusyBusy* for a period long enough for creating/changing a personal habit. Our hypothesis was that participants to this study would have developed or strengthened their capturing habit after playing the game.

Method. This study was limited to 5 students (referred to as P1 to P5) who classified themselves as experiencing stress. At the start of the study they filled in the survey in Appendix B, they then played *BusyBusy* for seven days in a row, and afterwards they filled in the survey in Appendix C.

Results. Out of the five people who took part of the experiment, two people already used to capture their thoughts externally before the experiment, two other people used to capture about half of the time, and the remaining person only sporadically. After the experiment, this stayed the same, except that one of the people who said about half the time answered sometimes, and the person who had answered sometimes answered about half the time. This means that their habits did not visibly change in the one-week period in which they played the

Table 2. Significance of responses to Q4 and Q5 in study 1.

Question	Group	<i>n</i>	Mean	Standard deviation	Variance	P-value
Q4	Experimental	19	4.11	0.72	0.87	0.035
	Control	43	3.60	1.10	1.22	
Q5	Experimental	19	3.16	0.93	0.87	0.945
	Control	43	3.18	1.27	1.60	

game; however 4 out of the 5 did confirm that playing the game did help them to practice capturing their thoughts. This can mean that the game helped to remind them of capturing their thoughts, possibly in a more organized manner. These results also reinforce the conclusion of Study 1, because 4 out of 5 people answered that they got more familiar with the thought capturing habit after the experiment ended. The results before and after are shown, respectively, on Tables 3 and 4. Refer to Appendix B and C for the questions.

Table 3. Answers before playing the game in study 2.

Q#	1	2	3	4	5
P1	1	Most of the Time	Always	I only keep them in my head	4
P2	1	About Half the Time	Always	On Paper	5
P3	1	Most of the time	Most of the Time	On Paper	5
P4	1	Sometimes	Sometimes	Digitally	3
P5	5	About Half the Time	About Half the Time	On Paper	3

Table 4. Answers after playing the game in study 2.

Q#	1	2	3	4	5	6
P1	1	Most of the time	About half the time	I only keep them in my head	4	All the time
P2	3	Sometimes	Sometimes	On paper	2	Sometimes
P3	4	Most of the time	Most of the time	On paper	5	Sometimes
P4	4	About half the time	Always	On paper	5	All the time
P5	3	About half the time	About half the time	On paper	5	Never

Discussion. The number of participants was limited and, in hindsight, the study should have been longer for the hypothesis being tested. In addition, it is hard to say how truthful the answers are. Nonetheless, it seems clear that playing everyday for about a week is not enough to increase the habit of a player to capture their thoughts externally. We believe a longer study will be needed to assess with more accuracy the effectiveness of the game for actually forming a habit.

5 Conclusion

Strong productivity habits are crucial for the next generation of knowledge workers, but most students are not sufficiently supported in developing such habits.

Due to their ability to engage players for extended periods, games have the potential to help create such habits. We presented *BusyBusy*, a serious game that helps students learn to capture and clear up their thoughts, following the steps of the proven Getting Things Done (GTD) methodology.

Preliminary evaluation has shown that playing *BusyBusy* raises the player's awareness of the value of capturing. Further research will be required to assess how effective *BusyBusy* is in creating and strengthening the player's capturing habit and what the limits of its applicability are.

We believe that *BusyBusy* provides a solid base to explore the acquisition of other habits in the GTD methodology. A natural development could include, for example, mini-games aimed at creating an in-game daily plan, to build the habits related to the *organizing* step. As always, the key for such habit building mechanisms will have to focus on keeping players engaged and rewarded for longer streaks. This, in turn, will require more content to be developed, most likely using advanced adaptation and procedural generation methods [11].

Acknowledgment. We thank David Allen and Arjan Broere for their support, enthusiasm and inspiring comments throughout this project.

Appendix A Survey Short Term Study

(Introduction) Thank you for taking the time to participate in this study measuring awareness and valuation of the capturing habit. The capturing habit is introduced by David Allen in his work Getting Things Done®. It refers to the habit of capturing your thoughts related to actions (such as buy milk, call a friend, study a chapter for a course) in a medium outside of your head. The survey contains 5 multiple choice questions and should take 2 min to complete. Your response will be completely anonymous.

(Q1) How familiar are you with the capturing principle?

(Q2) Where do you capture your thoughts?

(Q3) How often do you currently capture your thoughts, related to an action, outside of your head?

(Q4) How valuable is it for you to capture your thoughts outside of your head?

(Q5) How aware are you of the value of capturing thoughts outside of your head?

Appendix B Survey Before Long Term Study

(Introduction) Thank you for taking the time to participate in this study measuring awareness and valuation of the capturing habit. The capturing habit is introduced by David Allen in his work Getting Things Done. It refers to the habit of capturing your thoughts related to actions (which take more than say 2 min, such as buy milk, call a friend, study a chapter for a course) in a medium

outside of your head.

- (Q1) How familiar are you with the capturing principle?
- (Q2) How often do you currently capture your thoughts, related to an action, outside of your head?
- (Q3) How often would you like to capture your thoughts, related to an action, outside of your head?
- (Q4) Where do you capture your thoughts?
- (Q5) How valuable is it for you to capture your thoughts outside of your head?

Appendix C Survey After Long Term Study

(Introduction) Thank you for taking the time to participate in this study measuring awareness and valuation of the capturing habit. This is the final step of the experiment, hope you enjoyed it :)

- (Q1) How familiar are you with the capturing principle?
- (Q2) How often do you currently capture your thoughts, related to an action, outside of your head?
- (Q3) How often would you like to capture your thoughts, related to an action, outside of your head?
- (Q4) Where do you capture your thoughts?
- (Q5) How valuable is it for you to capture your thoughts outside of your head?
- (Q6) Has playing the game helped you capture your own thoughts externally?

References

1. Allen, D.: *Getting Things Done: The Art of Stress-Free Productivity*. Penguin, New York (2001)
2. Bada, S.O., Olusegun, S.: Constructivism learning theory: a paradigm for teaching and learning. *J. Res. Method Educ.* **5**(6), 66–70 (2015)
3. Clark, A., Chalmers, D.: The extended mind. *Analysis* **58**, 1 (1998)
4. Czerwinski, M., Horvitz, E., Wilhite, S.: A diary study of task switching and interruptions. In: *Conference on Human factors in Computing Systems (SIGCHI)* (2004)
5. Driscoll, M.P.: *Psychology of Learning*. Allyn and Bacon, Boston (2000)
6. Duffy, T.M., Bednar, A.K.: Attempting to come to grips with alternative perspectives. *Educ. Technol.* **31**(9), 12–15 (1991)
7. Evans, W., Kelly, B.: Pre-registration diploma student nurse stress and coping measures. *Nurse Educ. Today* **24**(6), 473–482 (2004)
8. HabitRPG Inc: Habitica (2020). nirvanahq.com. Accessed 05 July 2020
9. Heylighen, F., Vidal, C.: Getting things done: the science behind stress-free productivity. *Long Range Plan.* **41**(6), 585–605 (2008)
10. Jin, P.: Efficacy of tai chi, brisk walking, meditation, and reading in reducing mental and emotional stress. *J. Psychosom. Res.* **36**(4), 361–370 (1992)

11. Lopes, R., Eisemann, E., Bidarra, R.: Authoring adaptive game world generation. *IEEE Trans. Games* **10**(1), 42–55 (2018)
12. Stults-Kolehmainen, M., Sinha, R.: The effects of stress on physical activity and exercise. *Sports Med.* **44**(1), 81–121 (2014). <https://doi.org/10.1007/s40279-013-0090-5>
13. Murphy, R.J., Gray, S.A., Sterling, G., Reeves, K., DuCette, J.: A comparative study of professional student stress. *J. Dent. Educ.* **73**(3), 328–337 (2009)
14. Nirvanahq Inc: Nirvana for GTD (2020). nirvanahq.com. Accessed 05 July 2020
15. nTask: nTask (2020). ntaskmanager.com. Accessed 05 July 2020
16. Raelin, J.A.: Work-based (not classroom) learning as the apt preparation for the practice of management. *Manag. Teach. Rev.* **1**(1), 43–51 (2016)
17. Raelin, J.A.: Work-based (not classroom) learning as the apt preparation for the practice of management. *Manag. Teach. Rev.* **1**(1), 43–51 (2016)
18. Solomon, L.J., Rothblum, E.D.: Academic procrastination: frequency and cognitive-behavioral correlates. *J. Couns. Psychol.* **31**(4), 503 (1984)
19. SuperBetter, LLC: SuperBetter (2020). superbetter.com Accessed 05 July 2020
20. Tice, D.M., Baumeister, R.F.: Longitudinal study of procrastination, performance, stress, and health: the costs and benefits of dawdling. *Psychol. Sci.* **8**(6), 454–458 (1997)