DESIGNING WITH SELF-DETERMINATION THEORY: HOME-BASED DIGITAL EXERCISE INTERVENTIONS CREATING POSITIVE CHANGE

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ABSTRACT

The well-thought implementation of technology within the product-service system (PSS) will undoubtedly contribute to the increase of healthy life expectancy and to the improvement of the wellbeing of society. The 'Exercise-Well' project, explored the problem and solution areas related to home-based exercise through digital interventions. Students worked in pairs and expected to propose a PSS solution providing a type of sports/physical activities for individuals to support their wellbeing. The proposed solutions were encouraged to create positive change especially through the integration of self-determination theory (SDT), but also be functionality suited to the persona. The project had the goals of directing students: i) to learn how digital technologies can be best tailored to assist people to exercise; ii) to consider engineering and healthcare domain constraints for utilizing convenient technological methods and integrating relevant hardware and software components; and iii) to motivate people by integrating autonomy, competence, relatedness into their design proposals. The paper demonstrated how SDT can be integrated into the design process, and how home-based digital exercise interventions can lead to creative solutions.

Keywords: User centred design, Product-Service Systems (PSS), Industrial design

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1 INTRODUCTION

Although technological advances in the health sector mean that our life expectancy is prolonged, the time we spend in a truly healthy way is getting shorter. While the importance of being physically active is emphasized, to encourage a more active population globally, campaigners, health workers and policymakers across the world are looking for innovative solutions to these problems and implementing new design solutions. However, following a disciplined exercise program is a challenging option for many people. Although they know the benefits of being physically active, individuals may not be sufficiently motivated to perform routine physical activities due to lack of time, the sedentary lifestyle they have established, or loaded work tempos.

In the light of this, the implementation of technology within products, services and systems (PSSs) of well-thought solutions will undoubtedly contribute to an increase in healthy life expectancy and to the improvement of the wellbeing of society. In the absence of a good friend, smart technologies that track personal activity can help people overcome motivational barriers. Devices with this feature, which are capable of recording and analysing users' behavioural data, are designed to help people achieve the activity targets they set, follow the developments recorded over a certain period, and deliver health/exercise recommendations.

The work presented in this paper was carried out as part of the authors' ongoing research looking into ways of promoting people's health and wellbeing through digital health interventions and positive psychology. The research aims to generate informative and inspirational exemplars for further R&D in product design and innovation. As well as generating exemplars for product design, the specific 'Exercise-Well' concept design project reported in this paper explored the problem and solution areas related to home-based exercise through digital interventions. The project also had the pedagogical goals of directing students: i) to learn how digital technologies can be best tailored to assist people to exercise; ii) to consider engineering and healthcare domain constraints for utilizing the most convenient technological methods and integrating relevant hardware and software components; and iii) to motivate people by integrating three principal factors from self-determination theory (i.e., autonomy, competence, relatedness) into product and service design.

2 POSITIVE CHANGE

Despite many scientific efforts acknowledging the risks of digital technologies to wellbeing (Gaggioli et al., 2019), it is less common to find how technologies can be used to improve people's wellbeing. This observation inspired the development of the novel research area "Positive Technology", aiming to investigate the use of Information and Communication Technology (ICT)-based applications and services to foster positive growth of individuals, groups and institutions (Botella et al., 2012; Riva et al., 2012; Gaggioli et al., 2017). Positive Technology resulted from the convergence of two main research fields: Positive Psychology, and Human-Computer Interaction (HCI). The former is a fast-growing trend concentrated on the research and development of factors that enable flourishing of people (Seligman and Csikszentmihalyi, 2000). The scope of the field includes research on subjective, individual and group levels (Oades and Mossman, 2017). In HCI, the focus is on the importance that human experience, values, and ethical concerns have in the design, development and use of interactive systems (Gaggioli, 2019).

Research on Positive Technology has focused on achieving a positive change by associating Positive Psychology with the use of ICTs, through the design, development, and validation of novel digital experiences that aim at promoting positive change. The integration of Positive Psychology and HCI has led to new questions and possibilities concerning how digital technologies could help shape positive human functioning, strengths and empowerment (Botella et al., 2012). As expressed by Kanis and Brinkman: *"Naturally, most practitioners in the field of HCI aim to give the user a high-quality experience with technology, but designing technology that actually contributes to people's happiness in their everyday lives is a more complex challenge. There is clearly an opportunity to employ technology for positive change…"* (2009: 17). Gaggioli et al. (2019) highlight that filling the gap between existing wellbeing theories and immediately actionable design practices is a key challenge in Positive Technology. The general research area has benefited from diverse approaches and disciplines, including from Positive Technologies (Riva et al., 2012), Experience Design (Hassenzahl, 2010), Positive Design (Desmet and Pohlmeyer, 2013), Positive Computing (Calvo and Peters, 2014) and more recent efforts in Positive Product Design (e.g., Bigony, 2022). However, as highlighted by

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Peters, Calvo and Ryan (2018), the field requires a model based on methodologically sound approaches work, in allowing experience patterns to be developed, design strategies to be identified and positive experiences to be differentiated. Their proposition leverages the three core elements of 'Self-Determination Theory' (SDT) (Ryan and Deci, 2000) to provide positive change through sustained motivation and wellbeing. The theory concerns itself with human motivation, personality, and supporting people's natural or intrinsic tendencies to behave in effective and healthy ways.

SDT identifies three essential factors that represent the innate psychological needs driving human behaviour: *Autonomy* (a sense of choice and endorsement in a task); *Competence* (the experience of mastery over a task or particular domain); *Relatedness* (feeling cared for and connected with others; sense of belonging) (Martela, Ryan and Steger, 2018). Fulfilment of these needs impacts the quality of motivation and positive change in domain-specific outcomes. As for designers, extrinsic motivation can be used to motivate users to do various things or behave in certain ways. Therefore, SDT can be useful within design processes because it gives hints about how to provide the necessary attributes that users look for in products/services. Nevertheless, SDT has only very recently got the attention of design researchers and designers. Examples are scarce (e.g., integration of SDT into: co-design activities by Dent-Spargo, 2018; design of products/services to support better sleep quality by Sener, Umulu, and Yilmaz, 2022). Additionally, SDT has received significant empirical support in the context of health behavior change and specifically in the context of physical activity (Fortier, Duda, Guerin et al., 2012). These were major motivations to include SDT in the concept design project reported in this paper.

3 EXERCISE-WELL PROJECT

The 'Exercise-Well' project was carried out by 10 industrial design MSc and PhD students as an 8-week concept design project of the 'Design for Sports, Health and Wellbeing' course at the Middle East Technical University. Using the terminology and measures from the literature covered across the course, students worked in pairs taking a design for wellbeing approach to create a bond between an 'exercise-persona' and a final design proposal intended to deliver positive change. Each student pair was expected to propose a PSS solution focusing on a type or a variation of sports/physical activity for individuals (or a group) to support their wellbeing. Prior to the project, students took seven weeks of foundation classes in sports, health and wellbeing including the theoretical background (e.g., Positive Psychology, Positive Technologies) and strategies to leverage people's motivation, e.g., gamification strategies, SDT.

The project ran in collaboration with an industrial partner in the healthcare domain. The representative of the industrial partner was a health-tech entrepreneur, experienced in R&D, product development, serial production and marketing phases of Internet of Things (IoT) and ICT solutions. The industrial partner attended the classes to offer input on technologies applicable for measuring, processing and tracking, for example, vital data (body temperature, pulse rate, respiration rate, blood pressure) and joint tracking, relevant constraints of technology selections on design considerations, and to offer critiques for students' design development. Students generated their final design proposals based on different scenarios, personas and their specific physical exercise needs. They also integrated relevant motivation strategies to support final proposals, which led to a range of solutions from innovations to new approaches to existing products/systems.

3.1 Project scope

Students were expected to integrate the knowledge and terminology from the literature covered in the first half of the course to build a bridge between a constructed persona and a final design proposal. The proposed design solutions were encouraged to create positive change especially through the integration of SDT, and to be in line with positive design, but also be functionality suited to the persona that students constructed. The students were organized to work in pairs (5 pairs). As the concept design project brief was set within a relatively short graduate-level course, students were not required to deal with manufacturing processes or product assembly. However, careful selection and integration of digital technologies were essential. The solutions were stipulated not to be app only, but rather digital service extensions (e.g., mobile apps, web live streaming, offline content to watch, etc.) coupled with physical products were welcome. The following evaluation criteria were set for the project.

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- identifying and detailing a persona, specific exercise problem/need/opportunity, use context, and situating these in a consistent usage scenario; making a clear argument for how the final design proposal fits to an intended persona, identified exercise problem, and the scenario;
- providing solution for tracking and/or improving physical exercise quality;
- offering feasible technologies for tracking relevant exercise data;
- integrating the three principles of SDT (autonomy, competence, relatedness) and motivation strategies through the final design proposal;
- making a clear argument for how the design proposal and its digital and physical features fit the principles of SDT and motivation strategies.

3.2 Project stages and supporting activities

To provide the necessary foundations relevant to the project's scope, two guest lectures were organised. The first lecture was given by a medical doctor specialized in sports medicine and biomechanics, who introduced various topics including motion analysis in sports, benefits of physical exercise, types of activities (e.g., aerobic activities, flexibility activities, stretching activities, etc.) and tracking and analysis of these activities. The second lecture was offered by an expert in sports design and engineering, with extensive discussion and examples on the role of technology in promoting physical activity, and behavior change, as well as discussion on self-determination theory and people's (de)motivation to exercise. The guest lecturers accepted an invitation to join in the final design evaluations at the end of the semester. A Miro workspace was created for each student pair to document their design process. The project was managed across the following stages.

3.2.1 Sensitization activity: three basic psychologic needs analysis

In the authors' previous work, student feedback showed that since integrating SDT into the design process is a new direction students would need concrete outlines to follow (Sener, Umulu and Yilmaz, 2022) between SDT and quick in-class activities. In the Exercise-Well project, this was taken into account by offering students a sensitization activity, cue cards and in-class discussions. To guide the students about how they can relate autonomy, competence, and relatedness to PSS design, students were distributed with cue cards briefly mentioning the essence of each of the needs and example product features that would respond to those needs. Student pairs were then distributed different PSS solutions (including their videos, photos and explanations on the web) for physical exercise. They were asked to analyse the PSS with regard to the three basic psychologic needs (i.e., autonomy, competence, relatedness); identify (perceived) problems; suggest solutions; and finally, indicate what strategies they would employ to solve those problems, followed by a class discussion. This way, students became sensitized to the three basic psychologic needs and practised how PSS features can be associated with SDT.

3.2.2 Existing solutions for physical exercise

Each student was expected to review existing PSS solutions in the market that provide a type or a variation of sports/physical activities for individuals to support wellbeing, and/or assistive or preventive healthcare services/solutions. Ideally, the solutions should have targeted to track and/or improve exercise quantity and quality as well as motivate people in certain ways to sustain their activity levels. Commercial or conceptual solutions, or personally owned PSS solutions were included. The students were then asked to choose a PSS and give a brief presentation explaining what it is; how it works; where it is used; what technologies it embodies for data acquisition and communication during user-product interaction; whether it is targeted for a specific exercise type, user group or for more general use. The students were encouraged to include photos and videos, a system schematic, and an overview of customer reviews (for commercial products). They were also asked to make a brief analysis and give a commentary on the following. Does the PSS employ a positive design approach? Does it incorporate aspects of the three basic psychologic needs? If so, what functions/features/interaction, etc. of the PSS employ these? How would you develop the product to (better) motivate its users?

3.2.3 Identification of exercise-related opportunity, persona, key design considerations

Students were asked to develop a user persona, and if relevant, the main and secondary users that they will design their PSS solutions for. To guide the creation and representation of persona, a work-template

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was provided (Figure 1), with sections including the characteristics of the persona; specific exercise related problem/situation that the persona is experiencing; type of exercise the persona carries out/wishes to carry out; key design goals/concerns to respond to the persona's exercise-related problem/wish; motivation strategy/wellbeing approach; technologies that may help to achieve the design goals. Students were asked to work with their partners to discuss and elaborate on each of the sections by writing down and sketching out their notes.

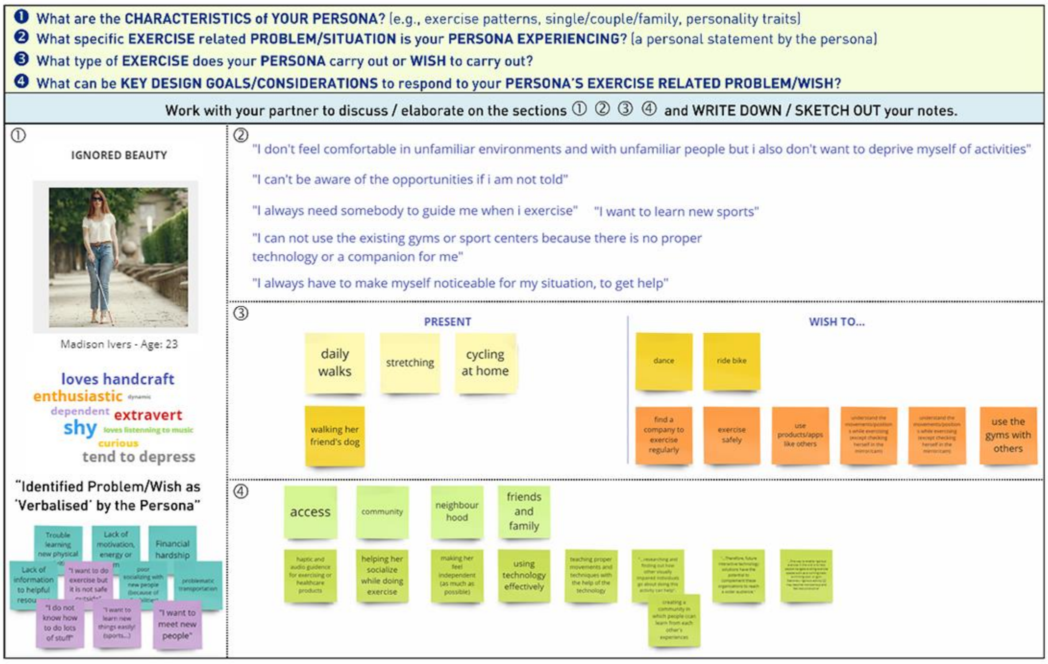

Figure 1. Work-template for elaborating on personas

3.2.4 Idea generation

Students commenced creative idea generation by sketching their initial ideas attending to system, service (app), product, and technology requirements. Ideation also included exploring the kinds of strategies (with special attention to three principles of SDT) for motivating users, relevant to their persona's needs within particular scenarios. Students were also expected to map the functions and features to relevant basic psychological needs. They were not expected to attend to all three needs equally (unless relevant), but rather argue to explain the reasons for empowering a specific need or combination of needs. Throughout this stage the students were supported with design critiques.

3.2.5 Interim project submission and student presentations

Each student pair was asked to present a single design idea within a relevant scenario. Storytelling was requested to bring the personas and scenarios to life, covering answers to questions mentioned at the previous stage. Some pairs preferred to support their storytelling with physical mock-ups. Students were given detailed feedback on the strengths and weaknesses in relation to all aspects of their ideas.

3.2.6 Concept development and specialist input on technical possibilities

Instructors continued to give regular critiques to students. The expert from the industrial partner offered a technical seminar on technology ecosystems for body activity tracking. The seminar covered topics including the types of sensors and sensing technologies that are relevant for body tracking (e.g., heart rate measurement–electrocardiography: ECG; muscle activity measurement–electromyography: EMG; physical movement and body orientation: accelerometers & gyrometers; and biosensors, etc.); ND activity tracking features (e.g., activity related health metrics such as respiration, movement patterns, pulse oximetry, body temperature, etc.). As well as becoming knowledgeable about the common data acquisition methods, possible limitations and implications on design, students were expected to evaluate which of the data acquisition methods might be most suited to their usage scenario. Additionally, students were supported through mini-lectures followed by in-class activities (e.g., on motivation, gamification), as well as take-home exercises and directed readings.

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3.2.7 Final submission and presentation

At the final stage students were asked to submit a Bēhance webpage together with 2-minute video presentation, and a project report. The webpage presented the key stages of the design process. The video included 3D renderings of the final design proposal illustrating the users, usage and interaction scenario, as well as details of the PSS, and where necessary supplementary text labels identify parts, features, technologies used etc. and the context of use. Finally, the report included a detailed account of the project stages and the final design proposal; including description of the design proposal; characteristics of the persona (covering personality traits relevant to project as well as responses to the questions mentioned in section 3.2.3); explanation of how the proposed design motivates the persona (to use it) and integrates the self-determination theory (autonomy-competence-relatedness); system diagram with ecosystem components (e.g., health IoT platform, mobile application, flow of interaction) explaining which technologies help to achieve the design goals; relations with healthcare services/solutions, and/or organizations by communities or social societies and/or interactions or collaborations with other stakeholders in the market; and lastly, the final design proposal presented within relevant scenario(s).

4 FINAL DESIGN PROPOSALS FOR POSITIVE CHANGE

The Exercise-Well project resulted in five diverse product proposals. The proposals varied based on the exercise-related problems that they tackled, the personas and specific needs they responded to; and the way they integrated SDT for positive change. All proposals took a PSS approach, designed as a combination of multiple physical product components and accompanying digital services to deliver complementary functionalities. ICT was implemented for tracking relevant health data for physical exercise and/or environmental conditions and giving relevant feedback to users.

Introducing students with the three basic psychologic needs from SDT during lectures, supportive in-class activities, and follow-up discussions was one of the main objectives in the course. The final design proposals showed that students were able to successfully transfer the SDT elements of autonomy, competence and relatedness to drive predicted positive changes in their personas' life through physical exercise and longer-term health benefits (Figure 2).

At the end of the semester, various aspects of the course were evaluated by students using a 5-point Likert scale survey. Remarkably, all ten students "strongly agreed" that the SDT direction adopted for the project was useful and opened their mind to ways that they had not thought about before. Student feedback gathered at the end of the course also supported this. Two example student comments were as follows:

> *"It was very productive to use everything we learned in the course (self-determination theory and three innate psychological needs) in the project, and to take them into consideration while developing our own design proposals. I started to pay attention to the presence of autonomy, competence and relatedness not only in this project, but also in other projects I carry out."*
>
> *"Until our first assignment (existing products and evaluation from the SDT perspective) I was unaware of how narrowly in scope we evaluate other products (existing in the market or concept level), and how superficially we discuss their good/bad aspects... I think criticism on other product examples (rather than just designing a "new" "innovative" or "never-thought" products) creates a sensitivity for improving our own design thinking and helps us to see improvement areas or promising ideas."*

The SDT elements acted as a driver for creative thinking and a motivating strategy for students to take a user-centred approach to their ideation, as well as giving students a direction or a new approach for crafting positive change through their design proposals.

5 CONCLUSIONS

As with most health behaviors, engagement in physical activity is a choice. Supporting people with well-suited product-service systems is a challenge for designers, as it requires carefully studied persona characteristics and relevant scenarios. Motivating users is an equally important consideration for designers to support positive change in people's lives to move towards healthy behavior choices. Self-determination theory proposes that healthy choices are more likely to be made and sustained when PSS offers levels of autonomy, competence, relatedness that users can associate themselves with.

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The Exercise-Well project was completed within eight weeks. The paper demonstrated how self-determination theory can be integrated into the design process, and how home-based digital exercise interventions coupled with a user-centered design approach can lead to creative solutions. Learning about SDT, and putting motivation principles into practice through a design project, is considered a valuable experience for students whose future professional roles may be to design innovative products for new generations of PSSs.

	PROPOSAL AND AIM	TARGET PERSONA	• AUTONOMY •	• COMPETENCE •	• RELATEDNESS •
HiiPACTIVE	 Compact system that encourages users to learn to be active and to reduce stress levels	**People with no previous experience of physical exercise who find it intimidating** (By İdil Aktaş, Tuğçe Sözen)	Colour options (Hiipband); Customisable gamified exercises and challenges with a freedom to join in as and when they want; Monthly workshops to choose from (with the coupons earned); Possibility to connect to app using different devices (e.g., mobile phone, TV).	Offers different gamified exercises at different ability levels according to users' stress levels; Provides different challenges to interact with other people; Users try to earn tangible rewards through coupons and badges.	Users can add friends and see each other's progress; Users can post their achievements on social media platforms.
FitMat	 At-home fitness system for post COVID-19 recovery embodying breathing exercises	**Individuals in need of regaining their strength in a fast and controlled way in the post COVID-19 period** (By Gökçe Deniz, Selami Erdoğan)	Highlighting exercise challenges; Tracking progress.	Allows many low and moderate intensity exercise types to be performed instead of single exercise type; Resistance bands with different hardness provide an exercise difficulty suited to development of the user.	Users can choose from varied movements within the scope of stretching, strength, balance, as well as breathing exercises; AI decision mechanism, which compares the exercise performed simultaneously with received data, determines most appropriate exercise program according to user's performance.
Fellow	 Interactive mat that enables users to focus, relax, and party!	**People who would like to be active but do not feel like doing exercise** (By Elif Dilara Bora, Ezgi Özkürkçü)	Optional instruction settings through audio, LED or vibration feedback; Optional activity intensity; Explanation level, instruction voice, LED colours and activity length.	Party Mode for use with friends; Being part of the online community to motivate each other; Joining weekly challenges and following trends in the community.	Having fun despite not feeling like doing an exercise; Designed in a way that there is no correct or incorrect way, users will feel like it is made just for them individually; Cares that people feel better when using the product.
FitBuddy	 Home-based gym that brings the equipment and social environment to home	**People who are looking to set up a basic progressive overload training cycle during the pandemic** (By Barış Bumin, Melis Dursun)	Optimised workload: making changes instantly to ensure correct muscles are exercised; Tracking: checking which exercises contribute to achievement of desired results; Options for training goals.	Selecting a training goal; Competing with oneself by tracking muscle efforts; Comparing oneself with other users (ranking chart); Creating time-limited challenges with other users.	Sharing workout summary and plan with other people; Seeing other users' workout plan; Exercising with other users.
MooV	 Smart exercise stick designed to coach and motivate people to exercise	**Especially for blind people, people with sight loss, or people who are not keen on interacting with digital screens** (By Gül Onat, Yaren Palamut)	Customizable training program; Customizable training content (seated / standing, with / without equipment); Music on / off option; Language / voice tone options; Silent mode.	Creation of user's body-model with estimated height, arm length, shoulder width etc.; Personalized for user's exercise / fitness level based on balance, flexibility, endurance and strength levels, heart rate and stability; Audio and haptic feedback during exercise to correct postures; Positive encouragement.	Personalized exercise content based on user's capabilities and exercise habits; Personalized communication: referring to users with their name; Reliable friend to offer guidance during exercise; Support for balance and movements (especially for those with visual impairments or loss).

Figure 2. Exercise-well proposals and their key features supporting SDT

The expert lectures by the guests and the project development critiques given by the industry partner representative were invaluable in making sure that identification of the exercise-related problems was realistic, and the solutions were technologically feasible. Final design proposals were evaluated by the course instructors, invited academic members, the industry partner representative and the guest lecturers invited at the start of the project. As imagined, students created diverse solutions: some add-ons to familiar products to expand them with new features; some were entirely new solutions; and some dealt with relatively less attended areas, all aiming to create positive change in people's lives.

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REFERENCES

Bigony, C. (2022), A Guide to Positive Product Design. https://www.positiveproductdesign.com/

Botella, C., Riva, G., Gaggioli, A., Wiederhold, B.K., Alcaniz, M., and Baños, R.M. (2012), The present and future of positive technologies. *Cyberpsychol. Behav. Soc. Netw*. No. 15, pp. 78–84. https://dx.doi.org/10.1089/cyber.2011.0140

Calvo, R., and Peters, D. (2014), *Positive Computing: Technology for Wellbeing and Human Potential*. Cambridge, MA: MIT Press.

Dent-Spargo, R. (2018), Using Self-Determination Theory to Support Co-Design Activities. In: Piotrkowicz, A, Dent-Spargo, R, Dennerlein, S, Koren, I, Antoniou4, P, Bailey, P, Treasure-Jones, T, Fronza, I and Pahl, C, (eds.) *CEUR Workshop Proceedings. CC-TEL 2018: Co-Creation in the Design, Development and Implementation of Technology-Enhanced Learning*, 03 September 2018, Leeds, UK.

Desmet, P.M.A. and Pohlmeyer, A.E. (2013), Positive design: An introduction to design for subjective well-being. *International Journal of Design*. No.7, pp. 5–19.

Fortier, M.S., Duda, J.L., Guerin, E. et al. (2012), Promoting physical activity: development and testing of self-determination theory-based interventions. *International Journal of Behavioral Nutrition and Physical Activity (IJBNPA)*, No.9, Article 20. https://doi.org/10.1186/1479-5868-9-20

Gaggioli, A., Riva, G., Peters, D., and Calvo, R.A. (2017), “Positive technology, computing, and design: shaping a future in which technology promotes psychological well-being,” in *Emotions and Affect in Human Factors and Human-Computer Interaction*, ed. M. Jeon (Cambridge, MA: Academic Press), 477–502. https://dx.doi.org/10.1016/B978-0-12-801851-4.00018-5

Gaggioli, A., Villani, D., Serino, S., Baños, R.M. and Botella, C. (2019), Editorial: Positive Technology: Designing E-experiences for Positive Change. *Frontiers in Psychology*, 09 July 2019. Sec. Human-Media Interaction. https://doi.org/10.3389/fpsyg.2019.01571

Hassenzahl, M. (2010), Experience design: technology for all the right reasons. Synth. Lect. Hum. Center. Informat. No.3, pp. 1–95. https://dx.doi.org/10.2200/S00261ED1V01Y201003HCI008

Kanis, M. and Brinkman, W.P (2008), Designing technologies that encourage the sharing of positive emotions. *Emotion in HCI: International Workshops*, Stuttgart, Fraunhofer IRB Verlag.

Kanis, M. and Brinkman, W.P. (2009), HCI for Positive Change, *13th Computer-Human Interaction Netherlands Conference*, June 11, 2009, Leiden, The Netherlands.

Martela, F., Ryan, R.M. and Steger, M.F. (2018), Meaningfulness as Satisfaction of Autonomy, Competence, Relatedness, and Beneficence, *Journal of Happiness Studies*, No.19, pp.1261–1282, Springer Science+Business Media: Dordrecht.

Oades, L.G. and Mossman, L. (2017), Chapter 2: The Science of Wellbeing and Positive Psychology. In Edited by Mike Slade, King's College London, Lindsay Oades, University of Melbourne, Aaron Jarden, Auckland University of Technology Wellbeing, *Recovery and Mental Health*, pp. 7-23. Cambridge University Press. DOI: https://doi.org/10.1017/9781316339275.003

Peters, D., Calvo, R.A. and Ryan, R.M. (2018), Designing for motivation, engagement and wellbeing in digital experience. *Frontiers in Psychology*, No. 9, Article 797. https://doi.org/10.3389/fpsyg.2018.00797

Riva, G., Baños, R. M., Botella, C., Wiederhold, B. K. and Gaggioli, A. (2012), Positive technology: using interactive technologies to promote positive functioning. *Cyberpsychology, Behavior, and Social Networking*. No. 15, pp. 69–77. https://dx.doi.org/10.1089/cyber.2011.0139

Ryan, R.M. and Deci, E.L. (2000), Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist Journal*, No. 55, pp. 68–78.

Seligman, M.E.P. and Csikszentmihalyi, M. (2000), Positive Psychology: An Introduction. *American Psychologist*, No. 55, pp. 5–14.

Sener, B., Umulu, S. and Yilmaz, A.O. (2022), “Digital Health Interventions for Promoting Sleep Wellbeing: A Design Approach Using Self-Determination Theory”. *24th International Conference on Engineering and Product Design Education: E&PDE* 2022. London South Bank University, UK. 8-9 September 2022.