International Journal of Game-Based Learning
Volume 13 • Issue 1

Career Choice With the Serious Game Like2be

Christopher Keller, University of Basel, Switzerland*
https://orcid.org/0000-0002-7956-6802

Elena Makarova, University of Basel, Switzerland
https://orcid.org/0000-0002-7033-9144

Anna K. Döring, University of Westminster, UK

ABSTRACT

Choosing a career is an important biographical event for adolescents. Toward the end of compulsory education, they must decide which career path they want to pursue. The serious game like2be was developed to support adolescents in this individual career choice process. In a quasi-experimental intervention study with 809 adolescents, like2be was evaluated for its effectiveness in career choice classes at the lower secondary level. In addition, a teaching concept for the application of the serious game which included additional teaching materials was analyzed. The data show that like2be is an effective medium for broadening personal career choice horizons, especially when it is pedagogically well-founded and integrated into career choice classes. Although the effectiveness of like2be in stimulating intensive reflection on one's own vocational aptitude or a gender-sensitive attitude towards occupations is limited, the present study shows that like2be has major potential for supporting the process of career choice among adolescents.

KEYWORDS

Career Choice, Career Orientation, Intervention Study, like2be, Serious Game

INTRODUCTION

The choosing of one's career is a pivotal moment for young people as they enter post-compulsory education. It signifies their initiation into a specific career path that is intertwined with personal development and life experiences. Career choice is not a one-time event but rather a multi-layered process related to individual personality that begins in early childhood (Brown & Lent, 2013). The closer adolescents get to the end of compulsory education, the more intensively they have to engage with their future career, as their first career decision inexorably looms.

DOI: 10.4018/IJGBL.327788
*Corresponding Author

This article published as an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0/) which permits unrestricted use, distribution, and production in any medium, provided the author of the original work and original publication source are properly credited.

For adolescents to successfully make the transition from compulsory schooling to post-compulsory education, a period of career exploration is particularly important (Hartkopf, 2013). Research shows that young people who engage in intensive career exploration during adolescence are particularly successful in making an individually appropriate transition to the world of work (Kracke & Schmitt-Rodermund, 2001; Neuenschwander et al., 2012). The digital learning game (serious game) *like2be* represents a promising opportunity for this. Specially developed for young people in the middle of their career choice process, *like2be* offers young people a playful opportunity to immerse themselves in a career exploration phase in order to explore their own career choice and to broaden their career horizons (Makarova et al., 2017b). Additional teaching material is available to add depth to the game's content.

Since the module *Career Orientation* as a cross-curricular career choice lesson was incorporated into the Swiss school curriculum (Lehrplan21) at the lower secondary school level (D-EDK, 2014, 2016), *like2be* has already been used several times at various schools. Owing to the game's innovative approach, empirical educational research has regarded *like2be* with significant interest, finally evaluating the game for its effectiveness. The results indicate that integrating the serious game *like2be* into classroom activities stimulates cognitive processes or provides mental challenges that lead to an increase in knowledge about occupations (Keller et al., 2023).

However, it remains unclear how or to what extent *like2be* should be integrated into career choice classes and whether its use leads to greater learning outcomes than traditional[1] teacher-prepared instruction. An intervention study was therefore conducted with adolescents in lower secondary schools in the German-speaking part of Switzerland. The study aimed to show to what extent *like2be* supports adolescents in their individual career choice process by helping them to a) increase their knowledge of occupations, b) improve their self-perceived fit with certain occupations, and c) have a more gender-neutral view of occupations. In addition, the data could be used to infer how *like2be* can be effectively applied in the classroom and how important a methodological-didactic teaching concept and the additional teaching material are.

THEORETICAL FRAMEWORK FOR CAREER CHOICE

Career choice is a significant milestone in life. Herzog et al. (2006) defined career choice as a dynamic and multifaceted process in which individuals, acting as active agents, gradually navigate and determine a career-related path. Throughout this process, they encounter various challenges and receive both societal and institutional restrictions and expectations. The theories presented in what follows examine each facet of the career choice process from a variety of perspectives; the section concludes with a synopsis.

Holland's (1997) Typological Theory of Career Choice states that individuals are more likely to prefer jobs that match their personality traits and interests. These characteristics are categorized into six groups represented by the acronym RIASEC.[2] Each individual is theorized to have a unique combination of these characteristics, which can be represented by their personal RIASEC code pattern and which may match certain occupations. High congruence between an individual's RIASEC code pattern and that of an occupation leads to an appropriate person-environment fit and increases the likelihood of success and job satisfaction (Holland, 1997).

While people are continuously influenced by reciprocal interactions with the environment (Swanson & Schneider, 2013), Holland's theory is considered rather static and may not fully account for the dynamic nature of career choice. Super's (1994) Life-Span, Life-Space Theory suggests that career choice is a lifelong developmental process depending on both personality and self-concept development. Adolescents first identify their career-related personality traits, interests, skills, talents, values, strengths, and limitations. They then gather information about the professional world and acquire the necessary skills through school and work experience. Based on their exploratory phase, they form a vocational self-concept that influences their career choice decision (Super, 1994).

Savickas's (2013) Career Construction Theory describes the career choice process as a script with three roles: self as actor, self as agent, and self as author. Individuals learn about their social environment and form their self-concept as the actor, define personal goals and adapt to individual challenges as the agent, and complete their career script by successfully navigating the transition to work or adulthood as the author. The interaction between the individual and social environment is crucial in shaping the career choice process (Savickas, 2013).

While the development of one's own personality or self is key in the process of choosing a career path, according to Gottfredson's (2005) Theory of Circumscription and Compromise, development of career aspirations is particularly influenced by factors originating in the social environment of young people. Social prestige and gender typology have a greater influence on career choice than interests, abilities, or attitudes. Adolescents are influenced by social stereotypes from an early age, leading to a pattern of career choices based on gender (Gottfredson, 2005). As a result, gender-specific occupational segregation occurs, which negatively affects both professional recruitment and the life chances of women and men (Makarova et al., 2017a).

In summary, career choice is a process wherein individuals seek a suitable fit based on their personality development, skills, and preferences as influenced by the social environment. Successful career choice is driven by the development of occupational interests, skills, personality traits, attitudes towards occupation and gender, and knowledge of occupations. Therefore, innovative learning technologies (e.g., serious games) would seem to be of great importance, especially for younger learners, in stimulating career choice processes in a positive way.

THEORETICAL FRAMEWORK FOR SERIOUS GAMING

Serious games are learning games that combine learning and fun. Their pedagogically valuable potential is emblematic of technological progress in the field of schools (Boyle et al., 2011). Breitlauch (2012) has emphasized that their use can lead to an increase in intrinsic motivation to learn and thus effectively support learning, because they are explicitly developed for specific target groups and thus meet their needs and abilities. Moreover, inherent reward systems are integrated into the games, creating special challenges for players (Hainey et al., 2011). They add a new dimension to information transfer. On the one hand, their digital and interactive simulation character, their game-like format (Vogel et al., 2016) as well as aspects such as competition in the game (Chen et al., 2020), and the triggering of a mental contest (Zyda, 2005) can increase learning motivation (Derbali & Frasson, 2012; Hung et al., 2014; Jong et al., 2013) and crucially promote learning. On the other, serious games allow for learning venues outside of school (Driesel-Lange & Ohlemann, 2019). In addition, they can offer students the opportunity to learn at a personally appropriate pace and to request individualized feedback or assistance (Makarova et al., 2017b). Although, the two terms serious games and games-based learning (GBL) are sometimes used synonymously, Corti (2006) mentions that GBL represents more of a sub-category of serious games. Additionally, Tang et al. (2009) considers GBL to be an innovative and effective learning approach using, among other things, computer games with educational value (e.g., serious games).

Recent empirical research shows that numerous companies (e.g., L'Oreal, Siemens, IBM, Cisco, Deloitte, and McDonald's) have successfully integrated serious games into their internal training strategy in recent years, resulting in a reduction in downtime, an increase in employee engagement, as well as an increase in revenue (Larson, 2019). However, serious gaming is more generally used in school educational contexts. Several studies show that serious games can effectively support students' learning at all levels of education: preschool, elementary school, secondary school, high school, and university (Karakoç et al., 2022; Tokac et al., 2019). Various meta-analyses mention that serious games can be used to enhance learning in school STEM subject areas (Hodges et al., 2020; Tsai & Tsai, 2020; Wang et al., 2022) and language acquisition (Dixon et al., 2022; McTigue et al., 2020). They can be particularly beneficial in the acquisition of mathematical skills (Byun & Joung,

2018; Tokac et al., 2019). Furthermore, large-scale studies report that in certain European countries serious games have been effectively used in different school subjects, ethics or art, and even as an intervention against school phobia in underperforming students (Wastiau et al., 2009). Moreover, serious games have been shown to effectively stimulate and enhance the learning processes of children and adolescents with disabilities in a school context. In this respect, serious games are considered to hold great potential with regard to inclusive schools (Keller et al., 2021a). Finally, they offer an effective and innovative alternative to implementing preventive measures, such as raising awareness of dangers on the internet (Iten & Petko, 2016), or stimulating attitudinal and behavioral changes, such as discouraging smoking (Bogost, 2007) or encouraging recycling (Boyle et al., 2011).

Although serious games have been used for learning purposes in many areas, they can by no means be assumed to guarantee effective learning. In the context of learning theory research, it is becoming apparent that learning and teaching have a complex relationship: to be effective it is necessary for the two components to be aligned with each other (Reinmann, 2013). A meta-analysis by Clark et al. (2016) points in a similar direction. They investigated how learning effects from serious gaming change when additional learning opportunities are integrated into the learning setting. They found that effects on students' learning increased significantly when teachers accompanied the serious gaming learning process with targeted scaffolding (Clark et al., 2016). Another more recent intervention study supports these findings: Hodges et al. (2020) evaluated the effectiveness of a serious game in science classrooms. The researchers found that students learned more effectively using the Virtual Vet serious game than those who learned with comparable analog classroom materials. In a further investigation, differences in the learning effect were initially demonstrated between those students who just played the game and those who also carried out other activities in the classroom. Specifically, those students who were part of additional learning activities in the school lessons showed higher learning effects than those who did not experience additional learning activities. However, when controlling for the additional learning time available in the group with extra activities, the researchers found no significant group difference. Of great relevance here is that the Virtual Vet serious game already includes a distinct scaffolding component, as supporting sequences were specifically integrated into the game which support the students' knowledge acquisition and the application of the acquired knowledge with regard to possible problem-solving strategies (Hodges et al., 2020).

Thus, it can be concluded that serious games are an innovative alternative for effective learning in both school and out-of-school contexts, are suitable for learners of all ages, and can have cognitive, affective, as well as motivational effects. At the same time, however, serious games do not appear to be self-perpetuating in terms of learning success. Instead, their effectiveness in the school context strongly depends on targeted additional scaffolding.

THE SERIOUS GAME *LIKE2BE*

The development of serious game *like2be* was supported by the Swiss National Science Foundation (SNF). It is web-based,[3] publicly accessible, and can be played free of charge in German, French, or Italian (Makarova et al., 2017b). It aims to provide an innovative opportunity, especially for teachers at the secondary level, to stimulate an intensive vocational exploration phase among adolescents.

In *like2be*, players take on the role of a job coach and are tasked with matching various, sometimes androgynous-looking, job-seeking avatars with suitable jobs from a pool of 44 different options within a specified time (see Figure 1). Each avatar has a personal profile, including a CV, and the players must consider the job requirements and benefits to make the best match. The game includes short statements about the requirements for the job and what it offers to the applicant, such as working hours, salary, and team size.

Learning outcomes due to the serious game *like2be* can be inferred on two levels. First, *like2be* follows a game-based learning approach and can therefore stimulate learning motivation and, in turn,

Figure 1. The like2be gameplay

Note. [1] Avatar, [2] job with requirements and benefits, [3] personal profile/CV, [4] specified time (IZFG University Bern, 2023b)

promote effective learning. Nevertheless, the abilities and the needs of the target group were also taken into account when developing the game (Makarova et al., 2017b).

Three mechanisms can be identified in *like2be* that can explain possible learning effects. First, players are randomly presented with suitable as well as unsuitable job offers each time they start the game. Thus, players have the chance to learn 44 more or less familiar occupations while simultaneously learning about the professional activity, requirements, and career opportunities involved. Although the randomization mechanism decreases the probability that players will learn about all 44 occupations, many can be discovered during longer game phases (e.g., a whole lesson period). Second, successful gaming is manifested by players matching job applicants with suitable and vacant jobs based on individual occupational preferences and skills. While playing, the gamers reflect on their own perceived fit with individual occupations by consciously or unconsciously asking themselves whether the occupation presented would also suit them. Finally, another randomization mechanism in the gameplay ensures that gender-stereotypical job placements do not lead to game success. Thus, the applicant profiles are assigned to a new avatar every time the game is started. To play successfully, players need to allocate jobs to applicants on the basis of their individual personal profile or resume (e.g., job-related interests, skills, preferences, life situation) and not on the basis of gender. Players recognize that gender should not be given much importance in the application process and are made aware of more gender-neutral career choices (Makarova et al., 2017b).

The game also features a three-part card set that provides additional playful activities for school lessons. These analog activities focus on diversity of occupations, questioning stereotypical job images, and creating flexible and versatile CVs or career paths. The card set is aimed at deepening the content of the serious game *like2be* and encouraging players to reflect on their own perceived fit with individual occupations while at the same time challenging gender-stereotypical job placements.

With the combination of the serious game *like2be* and subsequent activities using the additional card set, the following three goals are targeted: 1) students learn about new occupations and expand their knowledge of familiar and unfamiliar occupations; 2) students explore gender roles and gender typing of occupations; 3) students engage with diverse life histories and think critically about their

own abilities, interests, and aspirations (IZFG University Bern, 2023a, p. 7). The first two activities were integrated into the teaching concept for *like2be*.

THE TEACHING CONCEPT FOR *LIKE2BE*

Based on empirical research on the effectiveness of serious gaming (Reinmann, 2013) on the findings from a pilot study conducted with 169 adolescents at the end of 2018 (Keller et al., 2021b), a teaching concept for *like2be* was developed.

The teaching concept for *like2be* is a structured didactic scenario consisting of four school lessons aligned with the Swiss school curriculum. The teaching concept includes instructions for teachers to prepare for the lessons, additional documents and templates, and step-by-step activities with specific instructions for stimulating and leading discussions among adolescents. It is designed to promote active participation and critical thinking among students, and competency-based learning objectives are noted for each lesson.

Two of the lessons in the teaching concept for *like2be* are dedicated to playing the game, while the other two are for consolidation and scaffolding. In one consolidation lesson, students research occupations on a reference platform (Swiss Service Center for Vocational Education and Training, SDBB) and create a characteristic pattern for discussing who is suited to which occupation (based on RIASEC). In the other consolidation lesson, students play a card game linked to gender-stereotypical attitudes towards occupations. The teacher provides individual assistance throughout the learning process, and optional activities encourage individual reflection and stimulate a discussion on job and gender.

Overall, the teaching concept for *like2be* aims to provide teachers with a comprehensive guide on how to prepare, implement, and follow up on career choice lessons using *like2be* along with instruction for scaffolding and additional teaching materials to deepen the content and reinforce learning processes.

STUDY DESIGN

In order to determine how *like2be* supports adolescents in their career choice process by enhancing their occupational knowledge, perceived occupational fit, and gender-neutral perspective on occupations, a quasi-experimental intervention study was conducted at the lower secondary school level in German-speaking Switzerland using three study groups: a control group and two treatment groups. The study involved a pre-test (T_1) and post-test (T_2) after a six-week intervention period. The control group received conventional career exploration teaching, while treatment groups 1 and 2 played the serious game *like2be* for one lesson period spread over two weeks, with treatment group 2 also using the teaching concept material to deepen the content and scaffolding. Students assigned to the control group were taught the career choice lessons prepared by their teachers using traditional classroom materials, with no special career choice-related activities during this period (e.g., visiting a career fair); neither was *like2be* played nor were the additional serious game materials used in class. However, no equivalent paper-based learning material was developed for the control group as a comparison.

The data collected from T_1 and T_2 were analyzed to assess the effectiveness of *like2be* and the teaching concept on improving knowledge of occupations, self-perceived fit with specific occupations, and gender-neutral views of certain occupations. Three hypotheses (H_1, H_2, H_3) were tested:

1. H_1: The intervention with *like2be* results in group differences in self-perceived knowledge about occupations: Students in treatment group 2 will expand their knowledge about occupations more than students in treatment group 1 and the control group, and students in treatment group 1 will expand their knowledge about occupations more than those in the control group.

2. H_2: The intervention with *like2be* will result in group differences in self-perceived personal fit with occupations: Students in treatment group 2 will improve their perceived fit with specific occupations more than students in treatment group 1 and the control group, and students in treatment group 1 will expand their perceived fit with specific occupations more than those in the control group.
3. H_3: The intervention with *like2be* will result in group differences in gender-neutral views of occupations: Students in treatment group 2 will have a more gender-neutral view of occupations than students in treatment group 1 and the control group, and students in treatment group 1 will have a more gender-neutral view of occupations than those in the control group.

Sample

The total sample included 809 lower secondary school students from six different cantons in German-speaking Switzerland who had not previously played *like2be* in the classroom. After excluding incomplete data sets,[4] the final sample included complete T_1 and T_2 results from 532 adolescent students (65.76% of the total sample). Of these, 269 were young women (50.6%), 253 were young men (47.6%), and 10 were adolescents who assigned themselves to another gender (1.9%). The students were 12-17 years of age ($M = 13.77$, $SD = 0.82$). The sample showed a fairly even distribution of the three academic achievement levels[5] or streams, namely 175 adolescents (32.9%) from the school level with basic requirements, 158 (29.7%) from the school level with extended requirements, and 192 (36.1%) from the school level with high requirements. The data from seven adolescents (1.3%) could not be assigned to any school level. The adolescents of the final sample were assigned by class to either the control group ($N = 133$), treatment group 1 ($N = 220$), or treatment group 2 ($N = 179$). There was a balanced distribution of adolescents' age, gender, and academic achievement levels in each study group. Finally, a total of 435 adolescents (81.8%) indicated that they already had a desired occupation at the time of T_1.

Operationalization of the Constructs

To find out whether adolescents expanded their self-perceived knowledge of occupations through *like2be*, two different constructs were operationalized. The first was whether they learned about new occupations and the second was whether they increased their knowledge about certain occupations.

Regarding learning about new occupations, adolescents were asked at T_1: *Which of the following occupations do you know about?* At T_2 they were asked: *Which of the following occupations have you learned about in the past few weeks?* Subsequently, the adolescents were provided with a list of all occupations from *like2be*, which they could mark using checkboxes.

To record self-perceived knowledge about specific occupations, all those in *like2be* were bundled into superordinate occupational groups. For this purpose, the 22 occupational fields from the reference framework Berufsberatung.ch of the SDBB (Swiss Service Center for Vocational Education and Training) were used. Using the group Nature professions as an example, the young people were asked at T_1: *These are occupations from the field of "Nature": Landscape gardener, Civil engineer, Farmer, Florist. How much have you already learned about these occupations?* And T_2 asked: *How much have you learned about these occupations in the past few weeks?* At both T_1 and T_2, adolescents answered these questions using a 6-point Likert Scale ranging from *learned nothing* to *learned a lot*.

After the question about knowledge of specific occupations or occupational groups, adolescents at both T_1 and T_2 were asked: *Which occupations suit you?* in order to analyze self-perceived fit with specific occupations. For those that students checked as a fit, four filter questions followed: *How much does the occupation fit: (1) your skills, (2) your interests, (3) your personal characteristics, and (4) your gender?* Students rated the fit with skills, interests, characteristics, and gender on a 5-point Likert scale from *does not fit at all* to *fits completely*. Based on theoretical constructs, the authors formed a fit scale from the indicators of successful career choice. For this, the authors used

the results of the four questions about the fit of occupation to skills, interests, personal characteristics, and one's gender. The fit scale evaluates the strength of self-perceived fit to occupations based on the basis of the four indicators (skills, interests, personal characteristics, and gender). To determine the internal consistency of the fit scale, Cronbach's alpha was calculated for the subscale (4 questions in total). Internal consistency was acceptable at T_1, with Cronbach's alpha = 0.78, and high at T_2, with Cronbach's alpha = 0.82. The Cronbach's alpha values show in T_1 as well as in T_2 that the fit scale is reliable.

In terms of evaluating more gender-neutral attitudes toward occupations, adolescents were asked the following three questions at both T_1 and T_2: *How do you feel about the following statements*: (1) *There are occupations that are only suitable for women*; (2) *There are occupations that are only suitable for men*; (3) *All occupations are equally suitable for women and men*. Students recorded their opinions on each statement using a 5-point Likert scale ranging from *not true at all* to *completely true*. Subsequently, the authors formed an occupational gender stereotype scale from questions about whether there are occupations that are only suitable for women, men, or both equally. The occupational gender stereotype scale evaluates how strongly attitudes toward occupations are influenced by gender stereotypical beliefs. To determine the internal consistency of the gender stereotype scale, Cronbach's alpha was calculated for the subscale (3 questions in total). Internal consistency was high at T_1, with Cronbach's alpha = 0.81, and acceptable at T_2, with Cronbach's alpha = 0.79. The Cronbach's alpha shows at T_1 as well as at T_2 that the occupational gender stereotype scale is reliable.

Data Analysis Methods

In a pilot study conducted in 2018, a two-factor analysis of variance was performed, with study group as the between-subjects factor and the intervention period between T_1 and T_2 as the within-subjects factor. However, it was concluded from the pilot study that individuality and subjectivity have a strong influence on the data (Keller et al., 2021b). Therefore, an analysis of covariance (ANCOVA) was considered to be a more appropriate procedure. With ANCOVA, group differences are analyzed at a particular point in time (e.g., T_2) by controlling for data from an earlier point in time (e.g., T_1). Thus, changes within a certain period can be analyzed. An ANCOVA requires homogeneity of the regression slopes, in other words no interaction effect between the factor (study group) and the covariate (T_1), and variance homogeneity (especially in the covariate) (Rutherford, 2011).

Several ANCOVAs were conducted to test H_1, H_2, and H_3 with study group membership as the fixed factor. For H_1, two ANCOVAs were conducted. In the first, the number of known occupations was the dependent variable, while in the second, knowledge of occupations at T_2 was the dependent variable. Scores at T_1 were defined as covariates in both cases. For H_2, two additional ANCOVAs were conducted using the number of new fits with individual occupations at T_2 as the dependent variable in the first analysis and the fit scale scores at T_2 as the dependent variable in the second analysis. Scores at T_1 were defined as covariates in both cases. Finally, for H_3, the scores from the occupational gender stereotype scale at T_2 were the dependent variable, while the scores at T_1 were defined as covariate for the ANCOVA.

RESULTS

Descriptive statistics as well as findings from the ANCOVAs with respect to differences between the experimental groups in self-perceived knowledge about occupations (H_1), self-perceived fit with occupations (H_2), and gender-neutral attitudes toward occupations (H_3) are presented below.

Expansion of Knowledge About Occupations

Table 1 shows the descriptive data with respect to knowledge about occupations or occupational groups. The data indicate that knowledge about occupations at T_2 is highest among students in

treatment group 2, followed by those in treatment group 1, whereas knowledge about occupations is lowest among students in the control group.

After controlling for knowledge at the time of T_1, mean knowledge across occupations was significantly different between the three study groups, $F(2,529) = 5.39$, $p = 0.005$, $\eta^2_{partial} = 0.02$.

Bonferroni-corrected post-hoc analysis showed a significant difference between knowledge of occupations in treatment group 2 and the control group ($p = 0.041$, $M_{Diff} = 0.22$, 95%-CI[0.01,0.43]), but not between treatment group 1 and the control group ($p = 0.239$, $M_{Diff} = 0.15$, 95%-CI[0.05,0.35]), nor between treatment group 2 and treatment group 1 ($p = 1.000$, $M_{Diff} = 0.07$, 95%-CI[-0.12,0.26]).

Table 2 shows the descriptive data relating to knowledge of occupations or occupational groups. Unlike specific knowledge about occupations, the data relates to which and how many occupations students know about. The descriptive data show that knowledge of occupations at T_2 is highest among students in treatment group 2, followed by those in treatment group 1, whereas knowledge of occupations is lowest among students in the control group.

After controlling for knowledge at the time of T_1, the number of known occupations or occupational groups in the three study groups was not significantly different, $F(2,529) = 1.29$, $p = 0.275$, $\eta^2_{partial} = 0.01$.

Increasing the Perceived Fit With Occupations

Table 3 shows the descriptive data with respect to the number of fits with specific occupations. The data indicate that the fits with specific occupations at T_2 are highest among students in treatment group 1, followed by those in treatment group 2, whereas the fits with specific occupations are lowest among students in the control group.

After controlling for number of fits at T_1, the number of fits with specific occupations differed significantly among the three study groups, $F(2,529) = 4.28$, $p = 0.014$, $\eta^2_{partial} = 0.02$.

Games-Howell-corrected post-hoc analysis showed a significant difference between the fits with specific occupations of treatment group 1 and the control group ($p = 0.041$, $M_{Diff} = 0.93$, 95%-CI[0.03, 1.82]), but neither between treatment group 2 and the control group ($p = 0.110$, $M_{Diff} = 0.77$, 95%-CI[-0.13,1.66]), nor between treatment group 1 and treatment group 2 ($p = 0.915$, $M_{Diff} = 0.16$, 95%-CI[-0.78, 1.11]).

Table 4 shows the descriptive data regarding the change in the indicators for a successful career choice (fit of occupation with skills, interests, personal characteristics, and one's own gender)

Table 1. Self-perceived change in knowledge about occupations

Group	Self-Perceived Knowledge Before Intervention (Covariate, T_1)	Self-Perceived Knowledge After Intervention (Outcome Variable, T_2)
Control group	$n = 133$, $M = 2.55$, $SD = 0.81$	$n = 133$, $M = 2.09$, $SD = 0.77$
Treatment group 1	$n = 221$, $M = 2.50$, $SD = 0.85$	$n = 221$, $M = 2.27$, $SD = 0.90$
Treatment group 2	$n = 179$, $M = 2.50$, $SD = 0.75$	$n = 179$, $M = 2.31$, $SD = 0.79$

Table 2. Self-perceived knowledge of occupations

Group	Self-Perceived Knowledge Before Intervention (Covariate, T_1)	Self-Perceived Knowledge After Intervention (Outcome Variable, T_2)
Control group	$n = 133$, $M = 21.22$, $SD = 12.00$	$n = 133$, $M = 3.34$, $SD = 6.10$
Treatment group 1	$n = 221$, $M = 20.28$, $SD = 12.10$	$n = 221$, $M = 4.08$, $SD = 7.49$
Treatment group 2	$n = 179$, $M = 20.33$, $SD = 12.80$	$n = 179$, $M = 4.59$, $SD = 8.18$

Table 3. Self-perceived fits with specific occupations

Group	Self-Perceived Fits Before Intervention (Covariate, T_1)	Self-Perceived Fits After Intervention (Outcome Variable, T_2)
Control group	$n = 133$, $M = 6.02$, $SD = 3.17$	$n = 133$, $M = 5.41$, $SD = 2.94$
Treatment group 1	$n = 221$, $M = 6.31$, $SD = 3.94$	$n = 221$, $M = 6.56$, $SD = 4.33$
Treatment group 2	$n = 179$, $M = 6.43$, $SD = 3.62$	$n = 179$, $M = 6.52$, $SD = 3.75$

measured with the fit scale. The descriptive data show that the indicators at T_2 are highest among students in the control group, followed by those in treatment group 1, whereas the score is lowest among students in treatment group 2.

After controlling for the indicators of a successful career choice at the time of T_1, the indicators of a successful career choice in the three study groups were not significantly different, $F(2,490) = 0.38$, $p = 0.683$, $\eta^2_{partial} = 0.00$.

Gender-Stereotype Attitudes Toward Occupations

Table 5 shows the descriptive data with respect to gender-stereotype attitudes toward occupations measured with the occupational gender stereotype scale. The descriptive data show that the gender-stereotype awareness toward occupations at T_2 is highest among students in treatment group 2, followed by those in treatment group 1, whereas the gender-stereotype awareness toward occupations is lowest among students in the control group.

After controlling for gender-neutral attitude toward occupations at T_1, gender-neutral attitude toward occupations was not significantly different among the three study groups, $F(2,529) = 2.43$, $p = 0.089$, $\eta^2_{partial} = 0.01$.

DISCUSSION

The results presented in the previous section indicate that the serious game *like2be* can effectively contribute to learning, although its impact is limited.

Table 4. Self-perceived change in the indicators for a successful career choice

Group	Self-Perceived Indicators Before Intervention (Covariate, T_1)	Self-Perceived Indicators After Intervention (Outcome Variable, T_2)
Control group	($n = 125$, $M = 3.87$, $SD = 0.53$)	($n = 125$, $M = 3.94$, $SD = 0.62$)
Treatment group 1	($n = 201$, $M = 3.86$, $SD = 0.59$)	($n = 201$, $M = 3.89$, $SD = 0.64$)
Treatment group 2	($n = 168$, $M = 3.82$, $SD = 0.51$)	($n = 168$, $M = 3.86$, $SD = 0.60$)

Table 5. Gender-stereotype attitudes toward occupations

Group	Gender-Stereotype Attitudes Before Intervention (Covariate, T_1)	Gender-Stereotype Attitudes After Intervention (Outcome Variable, T_2)
Control group	$n = 133$, $M = 2.34$, $SD = 1.14$	$n = 133$, $M = 2.26$, $SD = 1.18$
Treatment group 1	$n = 221$, $M = 2.30$, $SD = 1.02$	$n = 221$, $M = 2.38$, $SD = 1.16$
Treatment group 2	$n = 179$, $M = 2.38$, $SD = 1.05$	$n = 179$, $M = 2.50$, $SD = 1.04$

Regarding H_1, that *like2be* would increase students' knowledge about occupations, the results from the data analysis show that the intervention with the serious game *like2be* caused significant group differences. Students in the experimental groups have higher overall scores on knowledge of occupations or occupational groups than those in the control group; however, those in experimental group 2 have statistically significantly higher scores than those in the control group but not than students in experimental group 1. Although the data suggest that the adolescents did not get to know any new occupations with *like2be*, the H_1 can be partially accepted.

At the time of T_1, adolescents reported that they already knew about, on average, 20 of the 44 or occupations from *like2be*. This corresponds to almost half of all occupations in *like2be*. Furthermore, at each game start avatars and person profiles (including CVs) are randomly selected by the serious game itself. Depending on this random choice, available occupations are selected. In this respect, the probability is high that with an actual playing time of two lesson periods (2 x 45 min) not all 44 occupations were presented or that some of the 44 jobs were presented several times. Thus, it is not surprising that the adolescents playing *like2be* became familiar with rather few new occupations.

Further, the students in treatment group 2 reported that they learned significantly more about occupations than those in the control group, particularly after controlling for the covariate (T_1). They also learned more about jobs than those in treatment group 1, although not statistically significantly. If the values of the descriptive statistics are examined more closely, it is noticeable that they range between 0.1 and 0.9. This may give the impression that the values are very small. However, since the students were surveyed by using a 6-point Likert scale (1-6), differences within this range were to be expected, especially when average values were calculated. It is particularly interesting that the results of the data analysis are consistent with the results of the theory on serious gaming. Following Reinmann (2013), the teaching concept precisely matched the application of the serious game *like2be* as well as its additional instructional material (in treatment group 2) to the available instructional sequences of vocational choice instruction. Likewise, the instructional design included targeted teacher-led scaffolding, which has been considered an important moderator of learning effects in previous studies (Clark et al., 2016). Although there is a significant group difference between students in treatment group 2 and those in the control group in terms of knowledge about occupations or occupational groups at T_2, the effect size is very small. Considering that in the study by Hodges et al. (2020) additional scaffolding produced large learning effects but activities to expand the topics of the serious games evaluated did not lead to learning effects, the question arises of whether the teaching concept should provide further opportunities for individual scaffolding instead of deepening the content of *like2be*. Furthermore, the data suggest that the use of *like2be* with the teaching concept led to slightly higher values but the difference from the treatment group that only played the serious game without supportive classwork remained rather small. In this regard, further analysis is needed to increase the learning effects of methodological-didactic instructional approaches.

Overall, the data show that the serious game *like2be* can effectively promote an expansion of knowledge about occupations in career choice education classes. In addition, it can be assumed that a teaching concept that instructs teachers in the use of the serious game, scaffolding, and additional activities in the classroom is of crucial importance.

With regard to H_2, that *like2be* would increase or change students' fits with specific occupations, data analysis can lead to the interpretation that the intervention with *like2be* partially led to changes in perception of fit. Thus, the results from the data analysis show that students in both treatment groups declared slightly more fits with individual occupations at T_2. In particular, treatment group 1 differed significantly from the control group but not from treatment group 2. In terms of the indicators of a successful career choice consisting of the perceived fit of occupation to one's own abilities, interests, personal characteristics, and gender, no group differences emerged. The intervention with *like2be* resulted in a statistically significant increase in students' fit with certain occupations. However, H_2 must be rejected. While both treatment groups benefited from the intervention, after controlling for T_1 outcomes, the data show that treatment group 1 had a significantly higher number of fits.

Career choice is described as a lifelong process (Gottfredson, 2005; Savickas, 2013; Super, 1994) associated with personal development (Super, 1994). The experiences an adolescent has in their childhood and teenage years shape them so that they themselves construct their vocational biography as a kind of author (Savickas, 2013). However, their career-choice related actions are guided by certain patterns that have become ingrained in their minds since early childhood. Such patterns, mostly stereotypical beliefs about occupations, ultimately have a decisive influence on the choice of education or training (Gottfredson, 2005). In this respect, it seems difficult to imagine that an intervention over the course of several weeks can stimulate reflection on personal career choice-related indicators to such an extent that a fit with new, previously unknown occupations will emerge or that the fit of previously known occupations that were considered suitable will be capable of change. In addition, it was found that in the final sample, 435 adolescents (81.8%) already had a specific career aspiration at the time of T_1. Nevertheless, the serious game *like2be* was able to draw the attention of the adolescents to a few occupations which they felt to be individually suitable. In this sense, playing *like2be* can be considered to be like the activity described by Swanson and Schneider (2013) as a two-way interaction with the environment that can influence career choice. In this respect, the serious game *like2be* proves itself to be an innovative way to increase the perception of fit with certain occupations and, following Hodges et al. (2020), does not seem to need any additional activities to deepen the content in order to be effective.

In the course of testing H_3, whether *like2be* would foster a more gender-neutral view of occupations among students, the data analysis can lead to the interpretation that the intervention had no significant impact on raising awareness of gender-neutral career choices. In this respect, H_3 has to be rejected.

A closer look at the descriptive statistics reveals that the intervention with the serious game *like2be* instead tends to intensify a gender-stereotypical career choice. Similar to perceived fit with occupations, it must also be mentioned with regard to sensitization to more gender-neutral attitudes toward occupations that gender-related views of or about individual occupations or occupational groups are already formed in early childhood. From these views, stereotypical patterns emerge that can have a directional influence on career choices in adolescence (Gottfredson, 2005; Makarova et al., 2017a). Viewed from this perspective, having any impact via a classroom intervention over a few weeks seems unrealistic. As with the debate around the fit with occupations, a study over a much longer intervention period would be of considerable interest.

Although two of the three hypotheses were rejected and only one could be partially accepted regarding the increase in knowledge about occupations, the serious game *like2be* represents a remarkable alternative in teaching career choice at secondary level. It is explicitly aimed at adolescents who are in the middle of an individual career orientation process. Moreover, it offers adolescents the possibility to broaden their individual career-choice related horizon in an interactive, playful format. The game features of a tight time limit for each round and the complex task of appropriately matching people with jobs as a virtual career coach provide special attraction and challenge. In this respect, *like2be* includes all aspects that can effectively support learning (Chen et al., 2020; Hainey et al., 2011; Vogel et al., 2016). In empirical research, it is often assumed that serious gaming causes an increase in motivation to learn and thus promotes learning (Derbali & Frasson, 2012; Hung et al., 2014; Jong et al., 2013). Whether the serious game *like2be* decisively influences learning motivation was not analyzed in the context of the present study.

Although empirical research shows that additional activities to consolidate and enhance content in the school context do not necessarily promote learning effects (Hodges et al., 2020) but that specifically guided scaffolding or scaffolding integrated into serious games effectively stimulates learning (Clark et al., 2016; Hodges et al., 2020), however, the data indicate that additional activities as well as scaffolding are relevant for effective learning. In this respect, a teaching concept seems to be a prerequisite for effective and efficient learning with serious games.

LIMITATIONS

Although the results suggest that *like2be* is an effective tool to support adolescents in their career choices, there are some limitations that need to be acknowledged.

First, the control group was not able to receive a learning arrangement equivalent to *like2be*, as Swiss teachers are free to choose their own teaching methods and materials. Teachers in the control group agreed to participate on the condition that they could deliver the career choice lessons as planned. Despite this limitation, the results demonstrate the effectiveness of *like2be* compared to traditional career exploration materials used in Switzerland.

In addition, although a teaching concept for using *like2be* in schools was developed and presented to lower secondary teachers, its implementation proved challenging due to time constraints. The intervention phase, which was originally planned to be longer and more activity-intensive, was shortened to only four lessons, two of which were dedicated to playing *like2be* and two to other classroom activities. However, given the lifelong nature of career choices, this intervention phase may have been too short to achieve more complex goals, such as critical reflection on career choice-related indicators or examination of gender roles and occupational typologies.

Finally, an exclusively quantitative study design may not be suitable to comprehensively evaluate the effectiveness of the intervention with the serious game *like2be*. On the one hand, only scales based on participants' self-assessment (e.g., self-perceived knowledge) could be used, as the randomization mechanisms in the game lead to learners learning different amounts about different occupations. On the other hand, the research field of career orientation is strongly characterized by individuality. In this respect, research designs based on a mixed-methods approach might be a more appropriate alternative to analyzing the effectiveness of serious games in greater detail.

CONCLUSION

Serious games have emerged as a promising and alternative method for facilitating effective learning. The serious game *like2be* demonstrated a degree of effectiveness in supporting young people in their career choice process. In particular, it effectively supported the adolescents in expanding their knowledge about occupations. However, its impact was limited in scope. There were some limitations, as it increased only the adolescents' consideration of more careers as a personal fit and their knowledge about specific occupations or occupational groups. It did not promote awareness of gender-neutral career choices or critical thinking about career-choice related indicators. The teaching concept developed for using *like2be* was found to be useful and appropriate, but the intervention period was too short to achieve complex goals. Thus, further research is required on scaffolding and instructional design (e.g., teaching concept) for serious gaming in the schooling context so that students can benefit from it.

ACKNOWLEDGMENT

The authors would like to thank all the teachers and students of the lower secondary schools who participated in the study and whose commitment contributed significantly to gaining knowledge about the effectiveness of the serious game *like2be*.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author(s).

FUNDING STATEMENT

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. Funding for this research was covered by the authors of the article.

AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

INSTITUTIONAL REVIEW BOARD STATEMENT

This study was reviewed and approved by the Ethics Committee and the Data Protection Officer of the University of Basel (date of approval 24 August 2021).

REFERENCES

Bogost, I. (2007). *Persuasive games* (Vol. 5). MIT Press. doi:10.7551/mitpress/5334.001.0001

Boyle, E., Connolly, T. M., & Hainey, T. (2011). The role of psychology in understanding the impact of computer games. *Entertainment Computing*, *2*(2), 69–74. doi:10.1016/j.entcom.2010.12.002

Breitlauch, L. (2012). Conceptual design for serious games regarding didactical and playfully requirements. In J. Wimmer, K. Mitgutsch, & H. Rosenstingl (Eds.), *Applied playfulness: Proceedings of the Vienna games conference 2011: Future and reality of gaming* (pp. 91-97). New Academic Press.

Brown, S. D., & Lent, R. W. (2013). *Career development and counseling: Putting theory and research to work* (2nd ed.). John Wiley & Sons.

Byun, J., & Joung, E. (2018). Digital game-based learning for K-12 mathematics education: A meta-analysis. *School Science and Mathematics*, *118*(3-4), 113–126. doi:10.1111/ssm.12271

Chen, C. H., Shih, C. C., & Law, V. (2020). The effects of competition in digital game-based learning (DGBL): A meta-analysis. *Educational Technology Research and Development*, *68*(4), 1855–1873. doi:10.1007/s11423-020-09794-1

Clark, D. B., Tanner-Smith, E. E., & Killingsworth, S. S. (2016). Digital games, design, and learning. *Review of Educational Research*, *86*(1), 79–122. doi:10.3102/0034654315582065 PMID:26937054

Corti, K. (2006). Games-based learning; A serious business application. *Informe de PixelLearning*, *34*(6), 1–20.

D-EDK. (2014). *Lehrplan 21 - Rahmeninformationen*. https://www.lehrplan21.ch/sites/default/files/lp21_rahmeninformation_%202014-11-06.pdf

D-EDK. (2016). *Lehrplan 21 - Broschüre Berufliche Orientierung*. https://v-fe.lehrplan.ch/lehrplan_printout.php?e=1&k=1&fb_id=13

Derbali, L., & Frasson, C. (2012). Assessment of learners' motivation during interactions with serious games: A study of some motivational strategies in Food-Force. *Advances in Human-Computer Interaction*, *2012*, 1–15. doi:10.1155/2012/624538

Dixon, D. H., Dixon, T., & Jordan, E. (2022). Second language (L2) gains through digital game-based language learning (DGBLL): A meta-analysis. *Language Learning & Technology*, *26*(1), 1–25.

Driesel-Lange, K., & Ohlemann, S. (2019). Perspektiven von Mädchen und Jungen auf schulische Berufsorientierung. In E. Makarova (Ed.), Gendersensible Berufsorientierung und Berufswahl: Beiträge aus Forschung und Praxis (pp. 200-218). hep.

Gottfredson, L. S. (2005). Applying Gottfredson's Theory of Circumscription and Compromise in Career Guidance and Counseling. In S. D. Brown & R. W. Lent (Eds.), Career development and counseling: Putting theory and research to work (pp. 71-127). John Wiley & Sons.

Hainey, T., Connolly, T., Stansfield, M., & Boyle, L. (2011). The use of computer games in education. In P. Felicia (Ed.), *Handbook of research on improving learning and motivation through educational games* (pp. 29–50). IGI Global. doi:10.4018/978-1-60960-495-0.ch002

Hartkopf, E. (2013). Berufswahlreife und Berufswahlkompetenz–zwei Schlüsselbegriffe der Berufswahlforschung und der Berufsorientierungspraxis aus psychologischer und pädagogischer Perspektive. In T. Brüggemann & S. Rahn (Eds.), *Berufsorientierung. Ein Lehr-und Arbeitsbuch* (pp. 42–57). Waxmann.

Herzog, W., Neuenschwander, M. P., & Wannack, E. (2006). *Berufswahlprozess. Wie sich Jugendliche auf ihren Beruf vorbereiten*. Haupt.

Hodges, G. W., Flanagan, K., Lee, J., Cohen, A., Krishnan, S., & Ward, C. (2020). A quasi-experimental study comparing learning gains associated with serious educational gameplay and hands-on science in elementary classrooms. *Journal of Research in Science Teaching*, *57*(9), 1460–1489. doi:10.1002/tea.21661

Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and work environments* (3rd ed.). Psychological Assessment Resources.

Hung, C.-M., Huang, I., & Hwang, G.-J. (2014). Effects of digital game-based learning on students' self-efficacy, motivation, anxiety, and achievements in learning mathematics. *Journal of Computers in Education*, *1*(2-3), 151–166. doi:10.1007/s40692-014-0008-8

Iten, N., & Petko, D. (2016). Learning with serious games: Is fun playing the game a predictor of learning success? *British Journal of Educational Technology*, *47*(1), 151–163. doi:10.1111/bjet.12226

IZFG University Bern. (2023a). *Elektronisches Lernspiel zur Berufswahl und didaktisches Begleitmaterial zur Vertiefung*. https://like2be.ch/content/2-educational-resources/1-de/1-kartenset/kartenset-like2be.pdf

IZFG University Bern. (2023b). *The serious game like2be*. https://like2be.ch

Jong, B.-S., Lai, C.-H., Hsia, Y.-T., Lin, T.-W., & Lu, C.-Y. (2013). Using game-based cooperative learning to improve learning motivation: A study of online game use in an operating systems course. *IEEE Transactions on Education*, *56*(2), 183–190. doi:10.1109/TE.2012.2207959

Karakoç, B., Eryılmaz, K., Turan Özpolat, E., & Yıldırım, İ. (2022). The effect of game-based learning on student achievement: A meta-analysis study. *Technology. Knowledge and Learning*, *27*(1), 207–222. doi:10.1007/s10758-020-09471-5

Keller, C., Doering, A. K., & Makarova, E. (2021a). The potential of serious games to foster learning among children and adolescents with disabilities: A systematic review. *Digital Culture & Education*, *13*(2), 6–36. https://www.digitalcultureandeducation.com/volume-13-2

Keller, C., Doering, A. K., & Makarova, E. (2023). Factors influencing the effectiveness of serious gaming in the field of vocational orientation. *Education Sciences*, *13*(1), 16. doi:10.3390/educsci13010016

Keller, C., Makarova, E., & Doering, A. K. (2021b). Förderung der Exploration im Berufswahlprozess mit Serious Games am Beispiel von like2be. In U. Weyland, B. Ziegler, K. Driesel-Lange, & A. Kruse (Eds.), *Entwicklungen und Perspektiven in der Berufsorientierung - Stand und Herausforderungen* (pp. 135–155). Barbara Budrich.

Kracke, B., & Schmitt-Rodermund, E. (2001). Adolescents' career exploration in the context of educational and occupational. In J.-E. Nurmi (Ed.), *Navigating through adolescence: European perspectives* (pp. 141–165). Routledge. doi:10.4324/9780203823033-6

Larson, K. (2019). Serious games and gamification in the corporate training environment: A literature review. *TechTrends*, *64*(2), 319–328. doi:10.1007/s11528-019-00446-7

Makarova, E., Driesel-Lange, K., Lüthi, J., & Hofmann, M. (2017a). Serious games in der schulischen Berufsorientierung: Ein Instrument der Entdramatisierung von Geschlecht? In M. Kampshoff & B. Scholand (Eds.), *Schule als Feld - Unterricht als Bühne - Geschlecht als Praxis* (pp. 180–198). Beltz.

Makarova, E., Lüthi, J., & Hofmann, M. (2017b). Innovative Wege einer gendersensiblen Berufsorientierung. In T. Brüggemann, K. Driesel-Lange, & C. Weyer (Eds.), *Instrumente der Berufsorientierung. Pädagogische Praxis im wissenschaftlichen Diskurs* (pp. 239–251). Waxmann.

McTigue, E. M., Solheim, O. J., Zimmer, W. K., & Uppstad, P. H. (2020). Critically reviewing GraphoGame across the world: Recommendations and cautions for research and implementation of computer-assisted instruction for word-reading acquisition. *Reading Research Quarterly*, *55*(1), 45–73. doi:10.1002/rrq.256

Neuenschwander, M. P., Gerber, M., Frank, N., & Rottermann, B. (2012). *Schule und Beruf. Wege in die Erwerbstätigkeit*. VS Verlag. doi:10.1007/978-3-531-94156-1

Reinmann, G. (2013). Didaktisches Handeln. Die Beziehung zwischen Lerntheorien und Didaktischem Design. In M. Ebner & S. Schön (Eds.), L3T. Lehrbuch für Lernen und Lehren mit Technologien. epubli.

Rutherford, A. (2011). *ANOVA and ANCOVA: A GLM approach* (2nd ed.). John Wiley & Sons. doi:10.1002/9781118491683

Savickas, M. L. (2013). Career construction theory and practice. In S. D. Brown & R. W. Lent (Eds.), Career development and counseling: Putting theory and research to work (2nd ed., pp. 147-183). John Wiley & Sons.

Super, D. E. (1994). A life-span, life-space perspective on convergence. In M. L. Savickas & R. W. Lent (Eds.), *Convergence in theories of career choice and development: Implications for science and practice* (pp. 63–74). Consulting Psychologists Press.

Swanson, J. L., & Schneider, M. (2013). Minnesota theory of work adjustment. In S. D. Brown & R. W. Lent (Eds.), Career development and counseling: Putting theory and research to work (2nd ed., pp. 29-53). John Wiley & Sons.

Tang, S., Hanneghan, M., & El Rhalibi, A. (2009). Introduction to games-based learning. In T. Connolly, M. Stansfield, & L. Boyle (Eds.), *Games-based learning advancements for multi-sensory human computer interfaces: Techniques and effective practices* (pp. 1–17). IGI Global. doi:10.4018/978-1-60566-360-9.ch001

Tokac, U., Novak, E., & Thompson, C. G. (2019). Effects of game-based learning on students' mathematics achievement: A meta-analysis. *Journal of Computer Assisted Learning*, *35*(3), 407–420. doi:10.1111/jcal.12347

Tsai, Y. L., & Tsai, C. C. (2020). A meta-analysis of research on digital game-based science learning. *Journal of Computer Assisted Learning*, *36*(3), 280–294. doi:10.1111/jcal.12430

Vogel, J. J., Vogel, D. S., Cannon-Bowers, J., Bowers, C. A., Muse, K., & Wright, M. (2016). Computer gaming and interactive simulations for learning: A meta-analysis. *Journal of Educational Computing Research*, *34*(3), 229–243. doi:10.2190/FLHV-K4WA-WPVQ-H0YM

Wang, L.-H., Chen, B., Hwang, G.-J., Guan, J.-Q., & Wang, Y.-Q. (2022). Effects of digital game-based STEM education on students' learning achievement: A meta-analysis. *International Journal of STEM Education*, *9*(1), 26. Advance online publication. doi:10.1186/s40594-022-00344-0

Wastiau, P., Kearney, C., & Van den Berghe, W. (2009). Games in school - How are digital games used in schools? Full report. *European Schoolnet*. http://games.eun.org/upload/gis-full_report_en.pdf

Zyda, M. (2005). From visual simulation to virtual reality to games. *Computer*, *38*(9), 25–32. doi:10.1109/MC.2005.297

ENDNOTES

1. Teachers in Switzerland are entitled to determine the methodological-didactic planning and implementation of lessons as well as the teaching materials to a large extent freely.
2. Realistic (Doers), Investigative (Thinkers), Artistic (Creators), Social (Helpers), Enterprising (Persuaders), and Conventional (Organizers) (Holland, 1997).
3. Official *like2be* homepage: www.like2be.ch.
4. A data set is considered incomplete if no data are available either at T_1 or at T_2.
5. At the lower secondary level, young learners are divided into three academic achievement levels based on their previous performance, teacher recommendations, and, in some cases, a test: 1) school level with basic requirements, 2) with extended requirements, or 3) with high requirements. The school system at the secondary level is permeable, making it possible to change school levels according to academic performance. The final achievement levels serve as prerequisites for education and training at the post-compulsory level.

APPENDIX

Abbreviations

ANCOVA Analysis of covariance
CV Curriculum Vitae
H_1 Hypothesis 1
H_2 Hypothesis 2
H_3 Hypothesis 3
PDF Portable Document Format
RIASEC Realistic, Investigative, Artistic, Social, Entrepreneurial, Conventional
SDBB Swiss Service Center for Vocational Education and Training
SNF Swiss National Science Foundation
STEM Science, technology, engineering, and mathematics
T1 Pre-Test; before intervention
T2 Post-Test; after intervention

Christopher Keller is a PhD Student at the Institute for Educational Sciences of the University of Basel. His research focuses on the effective integration of serious gaming into school lessons.

Elena Makarova is a Professor of Educational Sciences and the Director of the Institute for Educational Sciences at the University of Basel. Her research focuses on the heterogeneity and inclusion in the school environment, acculturation and cultural identity, adaptation of young people with a migration background, gender in the socialization and education process, vocational orientation and career choice, and values and value transmission.

Anna K. Doering is a Reader in Psychology and PhD Coordinator in Social Sciences at the University of Westminster. Her research focuses on the development of personal values from early childhood through adolescence to adulthood.