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Simulation of vocational activities: experimental evidence of (no) changes in vocational interests

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Abstract

Many school-age pupils are undecided about their future vocation. This often stems from a lack of occupational information or lack of vocationally related experience. The goal of this study was to develop and evaluate an intervention focused on the possibility of changing vocational interests through the simulation of vocational activities. The sample consisted of 250 pupils who were finishing primary school. The intervention was constructed for practical and artistic interests and consisted of workbooks that aim to simulate these vocational activities. MANCOVA showed no effect in the change of vocational interests among the pupils. An alternative idea of intervention in the form of virtual reality simulations is also presented.

Keywords: Vocational interests, Career exploration, Intervention, Development of interests, Exploratory behavior

Introduction

One of the most important decisions facing young people is choosing a future vocation (Hamilton and Krumboltz 1969; Vondracek and Porfeli 2003). This choice will potentially affect the direction of their lives. In the Slovak educational system, pupils have to make their first serious vocational choice after 8 or 9 years of primary school education (around the age of 15). At this point, they have to choose between three types of secondary schools: either a grammar school or one of two types of career-oriented vocational schools. For many pupils, this is a difficult task and as many as one third are not able to decide about their future vocation or field of study (Hrabinská et al. 2015; Pečjak and Košir 2007). This can lead them to seeking help from a career advisor. Career indecision is typically characterized as the lack of occupational information in general (Brown et al. 2012; Pečjak and Košir 2007) as well as a lack of information regarding an individual's career-related preferences (Gati and Tal 2008). While the first form of information can be relatively easily obtained and provided to pupils, the second one requires intensive introspection and "it is rare that individuals begin their career-decision process with a set of well-defined and crystallized career preferences" (Gati and Tal 2008, p. 161).

Career or vocational exploration

One of the goals of career counseling is to provide help and assistance to young people in finding the most suitable vocation or field of study through supporting their vocational exploration (Flum and Blustein 2000; Hamilton and Krumboltz 1969). Vocational or career exploration includes many activities that can enhance knowledge about oneself and knowledge about the world of work (Cheung 2015). While many young people are motivated to gather such information (e.g., through learning about various careers from textbooks, leisure activities, work experience, talking with parents or via the media) and explore their own interests, life goals and values (Porfeli and Lee 2012), this does not apply to all (Cheung 2015). Numerous interventions have been designed to foster vocational exploration or support career decision-making (e.g. Hirschi and Läge 2008; Janeiro et al. 2014; Koivisto et al. 2011; Santilli et al. 2018; Turner and Conkel 2010; Turner and Lapan 2005). Most of these consist of various activities such as the development of decision-making skills, elaboration of personally interesting careers, interpretation of the results from vocational interest questionnaires or providing career-related information. Brown et al. (2012, p. 3) has reviewed the existing meta-analyses and states that many “career interventions for choice-making difficulties are demonstrably effective but the magnitude of their effects is modest”. A more recent meta-analysis conducted by Whiston et al. (2017) has confirmed that the effect of career choice interventions is rather weak (Cohen’s *d* for vocational identity as an outcome variable was 0.21 and 0.40 for career maturity). Besides that, many of these interventions have only been evaluated in samples of college students, have only focused on the short-term effects or have not accounted for the pretest effect on the outcome variables (Hirschi and Läge 2008). In contrast to the high number of generally oriented career exploration interventions, there are few that are specifically focused on the development of vocational interests. This is surprising given that vocational interests and their profiles are considered to be the basis for vocational choices (Volodina and Nagy 2016; Savickas and Savickas 2017) with their measurement as the basis for vocational counseling (Armstrong et al. 2008). Vocational interests also predict future vocation (Fouad 1999), field of study (Lowman and Carson 2003) or various employment outcomes (Hoff et al. 2018).

Vocational interests, their structure and development

Vocational interests are defined as a relatively stable “pattern of likes, dislikes, and indifference regarding career-relevant activities and occupations” (Lent et al. 1994, p. 88). In vocational psychology, the plural form “interests” or “vocational interests” denotes a relatively stable predisposition. The best-known model regarding the structure of vocational interests is Holland’s hexagonal model. This is also known by the acronym RIASEC (Holland 1997). Holland’s theory is paradoxically regarded as a theory of interests rather than a personality theory, despite the author’s own description (Holland 1997). Likewise, its questionnaires are considered to be personality questionnaires as vocational interests are an important aspect of personality. The 6 letters in the acronym RIASEC represent the six personality and environment types where R stands for the Realistic type, I for the Investigative type, A for the Artistic type, S for the Social type, E for the Enterprising type and C for the Conventional type. The personality type as a

personality disposition influences thinking, perception and action in a specific way. Each of the 6 personality types possesses a different set of interests, abilities, preferred activities and occupations, values, coping mechanisms and self-concept (Holland 1997). By this, a person with a dominant Realistic type prefers regular or systematic manipulation with tools, instruments, animals or objects while a person with a dominant Artistic type prefers free, non-systematic activities associated with the manipulation of physical, verbal, or human material to create artistic products.

Instead of focusing on the plural form interests, research in educational psychology deals with the singular form “interest”. This is considered to be a psychological state reflecting current engagement with an object of interest (Krapp 2000, 2002). The change or development of (vocational) interests based on recurrent first-hand experiences with the object of interest (i.e. vocational exploration) primarily during childhood or adolescence is mentioned in Holland’s (1973, 1997) theory, Donald Super’s Life-span, life-space theory (Hartung 2013) and the Social Cognitive Career Theory (Lent et al. 1994). However, it is elaborated in more detail in theories from educational psychology. This is especially in the work by Hofer (2010), Krapp’s (2002) Person-Object theory of Interest or in the better-known Four-Phase Model of Interest Development (Hidi and Renninger 2006). The development of interests is described as a sequential transition from a short-term preoccupation with an activity (situational interest as a state) to a long-term disposition (individual interest). All these theories emphasize the importance of new experiences and stimulation from the environment to “trigger” the development of one’s interests. On the one hand, the environment can trigger development although on the other hand, it can also limit development in the sense that it “restricts the range and fields of exploration” (Hofer 2010, p. 151). Environmental factors include specific recommendations from parents, the hobbies and interests of friends, the availability of various leisure courses, content of school subjects, etc. This means that some areas facilitating the potential development of interest are more available than others. According to Dunkleberger and Tyler (1961), it is unrealistic to expect primary school pupils to have stable vocational interests. This is especially given their limited knowledge about the world of work, amount of time spent at school and ongoing psychological and physical ontogenesis. It is true that many students lack vocationally related experiences and hence also stable vocational interests (see e.g., Helwig 2003; Hoff et al. 2018; Tracey 2002).

Career exploration focused on the development of vocational interests

One of the few examples of career interventions specifically focused on the development or change of vocational interests are Krumboltz’s Job experience kits and an intervention designed by Betz and Schifano (2000). Krumboltz’s kits provide pupils with a simulation of work experience, each taking about 50 min to finish. However, their effectiveness has not been clearly confirmed (Bergland and Krumboltz 1969; Hamilton and Krumboltz 1969) and null findings were obtained by Betz and Schifano (2000). After a 7 h intervention they reported a significant increase (Cohen’s $d = 1.5$) of realistic confidence, but no increase in realistic interests. Their intervention consisted of slides and blueprints of architectural designs, a guided tour of a construction site and the use of hand tools to perform a variety of tasks, e.g. rewiring a lamp.

Some authors (e.g., Bernes et al. 2007; Guindon and Richmond 2005) are calling for more interventions, efficacy studies and experimental designs. There is especially an absence of career interventions for primary school-aged children (Perry and Wallace 2015).

The current study

The purpose of the present study was to a) develop an intervention focused on the possibility of triggering changes in the vocational interests of adolescents through the simulation of vocational activities and b) to evaluate its effectiveness. It is often the case that many young people not only lack first-hand experience with vocational activities or occupations but also fundamental knowledge about them (Babarović and Šverko 2016; Pečjak and Košir 2007; Vertsberger and Gati 2015). This is congruent with our own research experience with primary school-aged pupils. From the perspective of a young person, it could be difficult to assess the interestingness of vocational activities of which they have little experience or knowledge. Sometimes the answer “I do not like” in an interest questionnaire could only mean “I do not know”, if such a response option is not available. At the same time, significant changes in vocational interests happen during adolescence (Hoff et al. 2018). Taken together, the inability of pupils to accurately assess their interests as a result of this lack of knowledge and experiences may threaten the validity of the interest assessment.

Career counseling in Slovakia is mainly provided by Centers of Pedagogical and Psychological Counseling and Prevention (CPPPaP) or by educational counselors and school psychologists at school. The career counseling usually takes 2–3 meetings and consists of diagnostics and follow-up consultations (Machajová and Sojčák 2011). Given the limited time of these sessions, it is impossible to use career exploration programs such as Career majors, Internship/Apprenticeship or Job shadow (Visher et al. 2004), which are both demanding and time consuming. Therefore, the aim of this study was to create a new form of inexpensive, simple and less time-consuming simulation which would replace first-hand career-related experience. This would subsequently be evaluated in its effectiveness in inducing changes in vocational interests.

Hypothesis: It was hypothesized that completing the tasks included in the created intervention workbooks, as a simple form of simulation of vocational activities, would induce changes in practical and artistic interests in no a priori specified direction. Using the terminology from Krapp (2002) as well as Hidi and Renninger (2006), it should trigger a development of situational interest and a basis for the later development of individual vocational interests. The effect of first-hand experience with vocational activities, even in the form of a simple simulation, could increase as well as decrease the level of interest. Low motivation as the degree of involvement in the career decision-making process and certainty of vocational choice was controlled in the analyses. It was suggested that the probability of change in vocational interests would be lower in students who are not motivated or involved in the career decision-making process and would also be lower in students who are very certain about their choice of desired occupation (see e.g., Albion and Fogarty 2002; Gati et al. 1996; Paixão and Gamboa 2017).

Method

Participants

The sample consisted of 250 pupils (128 boys and 121 girls, 1 not identified) from Eastern Slovakia finishing their primary education, with an average age of 14.14 years ($SD = 0.67$). Out of these, 135 students were in the 8th grade and 115 in the 9th. The experimental group consisted of 131 pupils (58 boys and 61 girls) and the control group consisted of 119 pupils (70 boys, 60 females and 1 not identified). The sample was intentionally selected to capture the transitional phase between primary and secondary education and the processes that are naturally associated with it. The sample size was limited to 250 pupils due to financial constraints associated with the purchase of the Self-Directed Search copies. Therefore, instead of an a priori sample size estimation based on a power analysis, only a sensitivity analysis was performed. The sensitivity analysis was calculated in G*Power 3.1 (Faul et al. 2007) for the F tests family (ANCOVA) with alpha set to 0.0125 due to the four dependent variables. The analysis revealed there was 90% power to detect medium effects ($f = 0.261$).

Measures

Self-directed search

SDS, 5th Edition (Holland and Messer 2013; Martončík et al. 2017) is used to assess the degree of resemblance to each of the six RIASEC personality types formulated by Holland (1997). The SDS Assessment Booklet consists of several parts from which the subscale Activities measure vocational interests (6 scales with 14 items each). The reliability of the practical and artistic Activities subscales expressed by the omega total coefficient (post-test values are in parenthesis) were: $R = 0.89$ (0.92) and $A = 0.84$ (0.85).

Dotazník štruktúry všeobecných záujmov

DŠVZ [Structure of general interests questionnaire] (Džuka 1999) is a Slovak adaptation of the Der Allgemeine Interessen-Struktur-Test (Bergmann and Eder 1992, in Džuka 1999). It consisted of 60 items, 10 items measuring each of the RIASEC dimensions. A respondent expresses his or her interest on a scale from 1 (I am not interested at all, I do not like it) to 5 (I am very interested, I like it very much). The reliability of the practical and artistic interests subscales expressed by the omega total coefficient (post-test values are in parenthesis) were: $R = 0.86$ (0.84) and $A = 0.90$ (0.88).

Dotazník ťažkostí v kariérovom rozhodovaní

[Difficulties in career decision-making questionnaire] (Vendel and Bruncková 2016) measures specific difficulties in the career or major decision-making process. It consists of 8 subscales although only the subscale "Nízka motivácia" [Low motivation] was used. It uses 7 items to measure the degree of involvement in the career decision-making process. A respondent expresses his or her degree of agreement with the items on a scale from 1 (not at all) to 5 (extremely). The reliability expressed by the omega total coefficient was 0.79.

The certainty of vocational choice was measured by the question “To what extent are you certain about your vocational choice?” The respondent could answer on a scale from 1 (absolutely uncertain) to 9 (absolutely certain). The certainty of vocational choice and low motivation were only measured in the pretest.

Intervention

The intervention material consisted of workbooks with tasks that should resemble first-hand experience of activities presented in the Self-Directed Search (SDS). For example, if an adolescent is instructed to rate their interest in drawing a picture, we wanted to provide them with the opportunity to draw the picture. The workbooks were created only for practical and artistic interests as it was demanding to create them and the subsequent evaluation of six workbooks instead of two would require a larger sample and much more time. For reasons of replicability and comparability of results, the most frequently used interest questionnaire the SDS (Spokane and Holland 1995) was chosen as the measure of vocational interests. There were 27 tasks created to match every activity included in the items of the practical and realistic Activities subscale of the SDS. The tasks were accompanied with hints which helped the young people successfully complete all the tasks regardless of skills or knowledge. This feeling of competence is an important factor in increasing a person’s interest levels (Campbell and Hackett 1986; Hofer 2010). Both workbooks were pretested and verified whether students understood all instructions and were able to do the tasks without help with the exception of the included hints. The intervention materials—all workbooks with a description of the tasks are available in the OSF repository: <https://osf.io/8pfet/>.

Procedure

Students were randomly assigned (by drawing lots) to either the experimental or control group. In the experimental group, students were instructed to work through the workbooks and in the control group they were instructed to either do their homework or to fill in a different and unrelated questionnaire. The administration of the questionnaires and the intervention materials lasted 4 lessons (3 h) and was divided into 2 parts with a period of 2 or 3 days between the pretest and post-test. As the study wanted to capture the initial development of interests and did not expect any long-term changes after such a simple form of intervention, a short-term interval was the chosen period between the pretest and post-test. None of the theories (Hidi and Renninger 2006; Holland 1973, 1997; Lent et al. 1994) discuss the interval required for interests to change. Therefore, it was hypothesized that 2 days would be optimal to capture the short-term changes in preferences from the perspective of salience, duration and ability to recall the experience gained during the intervention. Since there were only 2 lessons per day granted to conduct the experiment, the pretest questionnaire with the intervention material for one RIASEC dimension was administered on 1 day and the post-test questionnaire with the materials for the other RIASEC dimension on the other day. In other words, half the pupils received the pretest questionnaire and the intervention materials for the practical interests on the first day and the intervention materials for the artistic interests was administered 2 or 3 days later together with the post-test questionnaire. The process of administering the intervention materials was reversed for the second half of the

pupils – they were administered the artistic interests on the first day. During the post-test administration, the pupils were instructed to think about whether they had changed their preferences as a result of the experiment. Two different interest questionnaires were used in order to control for the variability of responses and Type II error rate, as the SDS only has a binary answer scale and it was not allowed to be modified. Therefore, the DŠVZ questionnaire was added so that pupils could respond using a five-point Likert type scale.

The pupils were briefly informed about the nature of the research and were motivated by the fact that the tasks could improve their knowledge about the world of work and possibly help them in their career decision-making. They were instructed to work with the intervention materials as follows: “The tasks you find in the workbook are based on the items of the interest questionnaire you have already answered. The aim of these tasks is to provide you with experience of some vocational activities, particularly practical and artistic activities, in simple pen and paper tasks. Many pupils at your age have no prior experience or knowledge of these activities. Therefore, it is difficult for them to answer the questions in the interest questionnaires about whether they like each activity or not”. The workbooks also contained internal feedback-triggering questions as feedback is considered to play a crucial role in the process of exploration and formation of interests. Hofer (2010) also states that the conducted activity should be evaluated according to personal criteria of interestingness and must relate to personal goals in order to develop into an individual interest. For that reason, each task was followed by questions on a page labeled: “Na zamyslenie” [For your consideration.] which instructed students to think about the activity, e.g., “Have you enjoyed creating the screenplay?”, “Would you like to try changing car engine oil in real life?”, “Would you like to learn more about mechanics?”, or “Have you enjoyed inventing the cover of the magazine?”. The pupils were instructed to answer those questions (2 questions for each of the 27 tasks) only for themselves and their responses were not evaluated.

Data analysis

Overall, only 0.32% of the items were found to be missing from the dataset and the missing values were handled with the Expectation–Maximization method. The missing data were missing completely at random as suggested by Little’s MCAR test. The reliability values expressed by the omega total coefficient were calculated in JASP 0.9.2. MANCOVA was calculated in SPSS 23. The equivalence tests (two one-sided tests) were calculated in JAMOVI 0.9.5.12 using the TOSTER package (Lakens 2017). Equivalence tests are used to statistically distinguish whether the observed effects differ from the smallest effect size of interest, SESOI (Lakens 2017). Three datasets (the raw data, a dataset with imputed missing data, and a dataset with the pupils’ ratings of their knowledge about the interests) generated during the current study are available in the OSF repository: <https://osf.io/57mf6/>.

Results

The descriptive statistics, means and standard deviations for all the measured variables are presented in Table 1.

Table 1 Means and standard deviations of the interest scales and covariates

	Experimental group (n = 131)				Control group (n = 119)			
	Pretest		Posttest		Pretest		Posttest	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Practical interests (SDS)								
Males	6.19	3.72	5.62	4.03	4.54	3.74	4.76	4.47
Females	1.28	2.27	1.25	2.50	0.90	1.82	0.75	2.26
Artistic interests (SDS)								
Males	3.21	3.01	3.55	3.36	3.59	3.07	3.41	3.20
Females	6.08	3.63	5.97	3.60	5.90	3.67	6.20	3.96
Practical interests (DŠVZ)								
Males	2.48	0.76	2.38	0.79	2.24	0.76	2.29	0.85
Females	1.55	0.44	1.58	0.55	1.51	0.41	1.65	0.52
Artistic interests (DŠVZ)								
Males	1.64	0.73	1.79	0.82	1.76	0.71	1.88	0.76
Females	2.53	0.98	2.43	0.96	2.57	0.92	2.54	0.94
Certainty of vocational choice								
Males	6.11	2.38			6.38	1.56		
Females	5.78	2.20			6.17	2.19		
Low motivation								
Males	1.93	0.82			1.93	0.86		
Females	1.80	0.64			1.79	0.74		

After an experimental manipulation (completion of the tasks included in the intervention materials), the pupils had to rate their interestingness on a scale from 1 (not interesting at all) to 9 (very interesting). Both intervention materials were rated as interesting on average (for the practical interests $M=4.68$, $SD=2.45$ and for the artistic interests $M=5.10$, $SD=2.32$). There were also gender differences found in the ratings. Boys rated the practical interests tasks as more interesting ($g_{Hedges}=0.54$ with $M=5.33$, $SD=2.55$) than the girls ($M=4.03$, $SD=2.19$), whereas the girls rated the artistic interests tasks as more interesting ($g_{Hedges}=0.54$ with $M=5.71$, $SD=2.04$) than the boys ($M=4.48$, $SD=2.45$).

Confirmatory analysis. The effectiveness of the intervention materials in inducing changes in vocational interests was verified using MANCOVA with the post-test scores as the dependent variables and pretest scores as the covariates. The assumptions for the MANCOVA were met where the residuals had multivariate normality and the variances in the groups were roughly equal. There was no statistically significant difference between the experimental group and the control group on the combined dependent variables (practical and artistic interests measured with SDS and DŠVZ) after controlling for the uncertainty in vocational choice, low motivation in career decision-making and pretest interest scores, $F(4, 230) = 1.158$, $p = 0.330$, $Wilks' \Lambda = 0.980$, partial $\eta^2 = 0.02$. There was no statistically significant difference even at the level of items (instead of analyzing the summary scores for the SDS or mean scores for the DŠVZ, all items constituting particular interest subscales were analyzed, i.e. 14 items from each of the 2 SDS subscales and 10 items from each of the two DŠVZ subscales), $F(48, 141) = 0.858$, $p = 0.726$, $Wilks' \Lambda = 0.774$, partial $\eta^2 = 0.22$.

The presence of medium effects (Cohen's $d=0.5$) in the practical and artistic interests may be statistically rejected, based on the significant results of the equivalence testing carried out on the post-test scores.

Exploratory analysis. After seeing the previous results, it was decided to delve deeper into the data in order to find a possible meaningful mechanism of change (creating ex-post explanations). This is totally legitimate when they are properly reported as exploratory (Wagenmakers et al. 2012). It was suggested that there could be gender differences which are reflected in the different interestingness in the practical and artistic tasks. In other words, a change in artistic interests is more likely in females than in males and is vice versa for practical interests. Using MANCOVA with the control/experimental group and gender as independent variables, no statistically significant difference was found between the groups in terms of the combined dependent variables (practical and artistic interests measured with SDS and DŠVZ) after controlling for uncertainty in vocational choice, low motivation in career decision-making and pretest interest scores in the summary score or mean scores level, $F(4, 227) = 1.570, p = 0.183, Wilks' \Lambda = 0.973$, partial $\eta^2 = 0.02$ nor the item level, $F(48, 151) = 1.158, p = 0.724, Wilks' \Lambda = 0.785$, partial $\eta^2 = 0.21$. The presence of medium effects (Cohen's $d=0.5$) in artistic and practical interests may be statistically rejected, based on the significant results of the equivalence testing, carried out on the post-test scores. The only exception yielding a significant result were the practical interests measured with the SDS.

In order to verify the assumption about the generally low level of knowledge about the activities part of different vocations (interests) among the pupils, 102 pupils (a subsample from the whole sample) were asked to state whether they had had any first-hand experience with vocational activities represented by the items of the DŠVZ questionnaire or whether they knew these activities, nature and content. On average, 28.3% and 23.8% of the pupils answered that they had had no experience and did not even know the nature and content of either the practical or artistic activities, respectively. On average, students had had first-hand experience with only 17.4% of the practical activities and 28% of the artistic activities represented by the items.

Discussion

The question of whether it is possible to change vocational interests using a simple form of vocational activity simulation was examined in the present study. In a sample of 250 primary school pupils, there were no changes found in the practical and artistic vocational interests after the intervention. As the gender differences in vocational interests have been very well documented (Swanson and Gore 2000), the effect of gender was also analyzed although no changes in interests were found there either.

The current research idea was based on two assumptions which are likely related: 1) adolescents have minimum first-hand experience with vocational activities and a low level of knowledge about the world of work and 2) their interests are not fully developed and therefore have the potential to change. The age of the adolescents was chosen intentionally as this developmental period is considered by Bergland and Krumboltz (1969) as the most appropriate for exploratory activities as well as being full of changes in interests (Helwig 2003; Tracey 2002). Helwig (2003) found that children at the age of 7 changed their occupational aspirations many times during a 10 year longitudinal study. Therefore,

he stated that “counselors must be sensitive to the possibility that any given individual’s interests may change dramatically over time, thus making firm predictions of future interests risky” (p. 30). This may be related to the first assumption about the lack of opportunities for first-hand vocational exploration. It was found that, on average, pupils in the subsample had no first-hand experience and did not even know the nature and content of almost one-third of all the practical and artistic activities. Likewise, Grotevant and Durrett (1980) stated that the occupational knowledge of senior high school students in their sample was very limited. In that case, it is unrealistic to expect that all the pupils’ answers in the interest questionnaires would be fully valid.

There may be more than one interpretation of why this intervention had no effect on the change of interests. Failure to be sufficiently realistic and low level of interestingness in our intervention are considered the most probable ones. Taking into account the response format of the interestingness scale, our intervention materials rated as 4.68 and 5.10 points (on a scale from 1 to 9) which might be not interesting enough. However, this was the rating for the whole intervention workbook; it does not have to be an obstacle in the development of interests as not all activities are similarly interesting even in the real world. The pen-and-paper nature of the intervention materials is considered a much bigger problem as it does not allow us to realistically simulate all the activities. In addition, such materials could be seen as outdated in the current digital world and not interesting as a result. Even though some activities can be simulated using pen-and-paper very well (e.g., drawing a picture or writing news for a magazine), most of them cannot. Krumboltz, Babineaux, and Wientjes (2010) found that even a website displaying over 100 videos about various occupations to enhance career options was assessed as not interesting by online users.

The strongest voices in vocational psychology like Strong (1945), Super (1953) or Holland (1997) have suggested that interests develop and change in response to new experiences. Opportunities for first-hand experience must be created in order for young people to be able to develop new vocational interests. However, providing first-hand experience with all vocational activities in the RIASEC is impossible for career advisors. Rather, it is necessary to develop some form of simplified substitution which would allow adolescents to try many vocational activities that they do not know about or have never tried. It is believed that virtual reality could be one of the solutions to this. The use of this kind of simulation has been thriving in the last 10 years in pedagogy and various beneficial effects of simulation-based learning have been shown by many meta-analyses (Gegenfurtner et al. 2014; Hegland et al. 2017; Lorello et al. 2014; Oh et al. 2015). The application of virtual reality in simulation-based learning has also been discussed (Ke and Xu 2020; Keskitalo and Ruokamo 2011; Nubi and Vincent 2020). The newest IT technologies (3D laser scanners, photogrammetric scanners etc.) are able to transform any object with photorealistic quality into virtual space, capture its features and create complex scenes with many different situations. Thus, vocational activities could be recreated virtually and carried out by persons using 3D VR headsets and data gloves.

Limitations

A sample of 250 pupils and 90% power was only able to detect medium effects. It is not known whether smaller effects would be sufficient to trigger substantial changes in

interests. In order to be able to detect small effects ($f=0.10$) with 90% power, at least 1432 students would be needed which would be very financially demanding. Another limitation that could not be overcome is a different interval between the pretest and the post-test. However, it is believed that such a small difference should not possess any threat to the validity. It was not possible to have the same interval because the experiment was carried out during regular school lessons and it was necessary to adapt to the requirements of the school management. Furthermore, it would have been far better to use the SDS with a Likert type response scale to be able to detect more nuanced changes in interests than was possible with the use of a binary rating scale. Instead, it was necessary to use the DŠVZ as an additional measure with slightly different items, constituting another limitation. For future research, it would be interesting to also track the changes in affective and cognitive processing in accordance with the Four-Phase Model of Interest Development (Hidi and Renninger 2006).

Conclusion

A career intervention which is able to promote career maturity, adaptive career decision-making and the development of vocational interests in adolescents is highly needed. In a study carried out in Slovakia, Hrabinská et al. (2015) found that one-third of the sample (9360 pupils in their first year at secondary school) were not able to decide about their future field of study. Together with the importance of finding a suitable career or field of study during adolescence, this highlights the need to develop useful and effective career interventions. Even though the present study did not bring evidence for an effective intervention, its results could be beneficial for two reasons. (1) They contribute to a basis of knowledge about career interventions, providing evidence of what is effective and what is not, preventing the ineffective designs being needlessly reinvented over again. Similarly, a lack of credibility and the problem with the replicability of published results is, to a great extent, caused by publication bias. In other words, publishing only studies “that have worked” – studies with positive, clean and novel results (Munafò et al. 2017). (2) It could serve as an inspiration for the later development of career interventions based on the simulation of vocational interests as all data and intervention materials have been shared. We believe that all research, not only that focused on career interventions, should comply with open science practices for the good of replicability and advancement of science.

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Authors' contributions

MM conceived the main idea, theoretical framework, design of the study, acquisition and interpretation of data, and performed the statistical analyses. JB, LČ, NK, and MK conceived the design of the study, and acquisition of data. All authors have made a substantial contribution to this work. All authors read and approved the final manuscript.

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Availability of data and materials

Three datasets (the raw data, a dataset with imputed missing data, and a dataset with the pupils' ratings of their knowledge about the interests) generated during the current study are available in the OSF repository: <https://osf.io/57mf6/>. The intervention materials – all workbooks with a description of the tasks are available in the OSF repository: <https://osf.io/8pfet/>.

Ethics approval and consent to participate

Informed consent was obtained from all individual participants included in the study. All ethical guidelines were in accordance with established ethical standards as stated in the Declaration of Helsinki.

Competing interests

The authors declare that they have no competing interests.

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