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Health literacy promotion among young adults: a web-based intervention in German vocational schools

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Abstract

Against the background of an ageing population, the target group of young adults holds strong societal relevance as the future workforce. At the same time, young adults find themselves in a critical phase of life regarding the manifestation of a healthy lifestyle. In this context, young adults' health literacy gains importance. Web-based interventions implemented in educational settings offer the potential for promoting health literacy, although longitudinal studies remain scarce. Within a pre–post cluster randomized controlled trial with 6-month follow-up, this study investigated whether an 8-week web-based intervention in vocational schools (with or without an additional initial face-to-face measure) improves individual competencies within a structural model of health literacy ('self-perception', 'proactive approach to health', 'dealing with health information', 'self-control', 'self-regulation' and 'communication and cooperation'). The control condition was regular school lessons following the curriculum only. A multi-level regression analysis was performed using the control group as reference. None of the interventions showed a significant improvement in any of the dimensions. Significant differences between the intervention and control were obtained for some dimensions, albeit showing reductions. Future research must examine how to build impactful health literacy promotion in educational settings. Investigations into linking digital and face-to-face measures should continue.

Introduction

Today, especially in high-income countries, the population is ageing; e.g. in Germany, 28% of the population was aged 60 years or older in 2017, which is one of the highest rates in the world [1]. In light of this demographic change, the target group of young adults holds strong societal relevance as a future workforce [2, 3]. At the same time, it is widely acknowledged that young adults find themselves in a distinct life phase. The years between adolescence and adulthood—also called 'emerging adulthood' (age span 18–25 years) [4]—are characterized by changing life circumstances, developing personality and exploring possibilities [4, 5]. In this context, young adults' health gains significance.

During young adulthood, both healthy and unhealthy behaviours and health-related risk factors manifest [6–8]. Studies report decreasing physical activity [9], weight gain and unhealthy eating habits [10, 11]. Additionally, rates of binge drinking, smoking and drug use increase compared with

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during adolescence [12, 13]. Young adults' urge for self-exploration, personal independence and less social control can explain such excessive behaviours [4, 14]. Moreover, young adults use less preventive care compared with both younger groups and older adults [15, 16].

Against this background, young adults' health literacy becomes increasingly important [17]. Health literacy is understood as the ability to access, understand, appraise and apply information to make health decisions [18] and be competent regarding decisions in health-related situations [19, 20]. Being health literate means owning a set of cognitive, social and motivational skills that result in healthy behaviour and disease prevention in everyday life [21, 22]. Research shows that interventions targeting healthy behaviours can promote health literacy [23]. Furthermore, it is already established that being more health literate increases the likelihood of health-promoting behaviours like a healthy diet and being physically active [24], while a lowered health literacy is associated with reduced self-rated health [25]. Health literacy is considered as key determinant of health [26]. Addressing health literacy at an early age can lead to positive health outcomes and behaviours later in life [27].

Despite the challenges of the life phase of 'emerging adulthood', the target group of young adults is still considered underrepresented in research and practice [28–30]. Health-promoting measures are still lacking, especially in non-academic settings [31, 32]. A promising approach to reach young target groups in health promotion is through new media [33–35].

Particularly among young users, the internet is the main source for health-related information [36–38], and the majority of young online health seekers trust the information found online [38]. However, despite its potential, web-based interventions often lack long-term effectiveness [39, 40]. Furthermore, longitudinal studies and digital measures to promote health literacy remain scarce [41, 42].

A reasonable strategy for implementing web-based interventions is integrating them into social contexts, e.g. educational institutions [43, 44]. Educational settings are central in promoting and strengthening young people's health literacy [17, 21, 45], and interventions in school settings are shown to be a comparatively efficient way to promote healthy behaviours [46]. Educational settings should empower young people to make health-enhancing decisions [47, 48]. Approaches should consider the perceptions, attitudes, behaviour, learning and media channel preferences of the young target group [26].

The present study aims to examine whether an intervention study using a web-based platform (with or without an initial face-to-face measure) in vocational schools is effective in terms of promoting health literacy among young adults (eight intervention weeks and a 6-month follow-up) compared with regular school lessons following the curriculum.

Materials and methods

Study design

The WebApp study [49] was a three-armed cluster randomized controlled trial (RCT) with three measuring points (Fig. 1): T0 = baseline (start of the intervention) in February and March 2017, T1 = end of 8-week intervention and T2 = 6-month follow-up. Three forms (overall 33 classes) from three different vocational schools were randomized to three different study conditions: web-based intervention (*WEB*), web-based intervention with an initial face-to-face measure (*WEB + FTF*) and control (*CON*). The ethics committee of the German Sport University Cologne has approved the study (reference: 118/2015).

Participants

All participants were recruited based on project-related cooperation agreements between the German Sport University Cologne and three vocational schools from Cologne and were completing commercial vocational training. In Germany, the vocational training is split into general education at schools and job-specific teaching at apprenticing companies and it typically lasts for 3 years. The students were in the first year of training, except for one class.

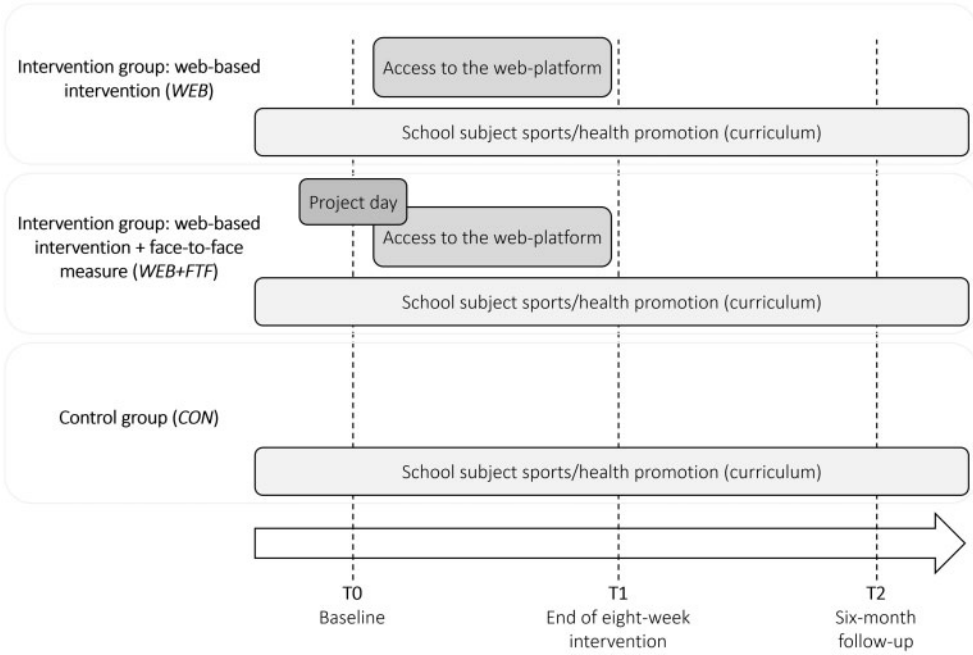

Fig. 1. Study design (cluster RCT).

Participation was voluntary. Study conduct did not affect regular school lessons during the length of the study. For the study evaluation, all students aged 18–25 years were included following Arnett's conception of 'emerging adulthood' [4]. Data of underage students and participants of retraining courses outside the age span were not included in the analyses. Written informed consent was obtained from all participants of the sample.

Intervention

The main aim of all three study conditions was to strengthen the competencies of young adults regarding a healthy lifestyle.

Web-based intervention

The web-based platform used for the study was developed based on focus groups with vocational school students, which were conducted in an earlier stage of the project. The results are presented elsewhere [50]. In order to realize the study platform, e-learning software was used to create a structured web-based course. One school year prior to the presented cluster RCT, a pilot phase (8 weeks long) was conducted with another grade [51]. The pilot phase aimed to test the technical feasibility and reliability of the approach [49].

The homepage of the web-based platform displayed a newsfeed with updates and news. Via the homepage header, several sections of the platform were accessible, including the learning modules and community features (personal messages and forums) (Fig. 2). The software provided responsive design for a proper display on both computer/laptop screens and smartphones.

The modules section covered seven specific topics (Table I) with weekly updated learning units. The primary thematic focus was placed on the everyday working life of the vocational school students, in this case, office work. In general, the content aimed at self-perception, occupational burdens and self-organization. The content had an interactive layout (clickable graphics) using different multimedia formats (texts, animations and

Fig. 2. Homepage of the web-based platform.

Table I. *Modules and updated learning units accessible on the web-based platform during the 8-week intervention period*

Topic	Content description
General information (main focus: physical activity)	The learning units dealt with health-enhancing physical activity both at the workplace (office setting) and in leisure time, suggestions for improved ergonomics, counteracting physical workloads, short workouts and how to overcome barriers. The unit should provide tips for a proactive approach to health.
Clarification of misinformation	The 'Mythbusters' module dealt with frequently repeated misinformation regarding physical activity to sensitize for critical handling of health information.
Healthy nutrition	The 'Powerfood' module dealt with the fundamentals of healthy nutrition, starting with breakfast up to the evening meal. Additional information was provided about snacks (at the office), water balance and healthy drinks.
Quick recipes	The units included weekly recipes as an addition to the 'Powerfood' module to support individual health-promoting behaviour.
Motivation	The 'Push YOU' section included short clips that were uploaded in which students and employees of the German Sport University Cologne explained their strategies regarding self-organization, self-control and maintaining healthy behaviours.
Check-ups	In the 'Checkpoint' section, four short self-assessments regarding strength, coordination, endurance and healthy nutrition were provided to improve self-perception.
Quizzes	The 'Quizmaster' section included short quizzes about health-related topics.

videos). Any content was tailored to the target group concerning language (direct speech and avoidance of academic language), extent and complexity.

Participants of both intervention groups received invitation emails with individual access data after the pre-measurements. All users received brief weekly email reminders describing new content.

Web-based with an initial face-to-face measure

In addition to the access to the web-based platform described above (*WEB*), a school health day was conducted in one vocational school during a regular school day (obligatory participation) before the start of the intervention. The health day comprised different subject stations that were passed in turn by the classes. The topics were occupational health management, short relaxation at work and stress management, healthy nutrition, fitness tests, health check-ups and the presentation of the web-based platform. The health day aimed to sensitize the students for health topics and their health status and introduce the web-based platform through personal contact. The primary thematic focus was placed on preventing occupational burdens.

Control

During the study, all classes of all three study arms continued to participate in regular lessons within the school subject of sports/health promotion. *CON* received no additional access to the web-based platform. According to the curriculum of the federal state of North Rhine-Westphalia, the subject sports/health promotion is compulsory across all vocational trainings and aims to contribute to the personality development of the students. The curriculum names six competence areas: taking care of one's one body, dealing with occupational burdens, self-representation and development of creativity, assumption of responsibility, self-organization and performance development, communication and cooperation [52]. The education aims to support a self-determined health-promoting way of living.

Measures

Health literacy was measured at baseline (T0), after the 8-week intervention (T1) and 6-month follow-up (T2) based on Lenartz's German questionnaire on health literacy [19]. The questionnaire depicts the structural model of health literacy by Lenartz and Soellner *et al*. [19, 22]. The questionnaire comprises 29 items forming the six individual dimensions of the model (Table II): 'self-perception' (five items) and 'proactive approach to health' (five items) as perceptive-motivational conditions and 'dealing with health information' (five items), 'self-control' (five items), 'self-regulation' (five items) and 'communication and cooperation' (four items) as behavioural components. The response options are 'not correct at all', 'rather not correct', 'rather correct' and 'correct' (scale 1–4). Following the manual, the values of each dimension are calculated by generating the mean value of the belonging items [19]. The questionnaire was shown to be reliable and valid with different samples [22, 53].

Additionally, sociodemographic data (age, sex and height and weight for body mass index [BMI] calculation) were collected via questionnaires.

Statistical analysis

A multi-level regression analysis was performed using the control group as reference to examine the effect of the intervention regarding the six dimensions of the structural model of health literacy. The analysis was adjusted for baseline values. The significance level was adjusted for multiple testing. Analyses were run with Stata Version 14.

Results

Sample description and baseline data

Overall, the baseline sample had a mean age of 20.7 ± 1.9 years, 59.0% were female, and the mean BMI was $23.9 \pm 4.4\,kg/m^2$. Health literacy scores for the six dimensions varied between 2.6 and 3.0. Table III shows the baseline data of the study groups.

Study participation

Figure 3 illustrates the participation flow within this study. A total of 531 vocational school students participated in at least one of the three measurement time points. At baseline, 495 vocational school students filled out the questionnaires (*WEB*: 149, *WEB* + *FTF*: 187 and *CON*: 159). In total, 157 vocational school students (29.6% of the whole sample) participated in all three measurements (*WEB*:

Table II. *Dimensions and example items from the questionnaire on health literacy*

Health literacy dimension	Example item
Perceptive-motivational conditions	
Self-perception	'If I feel uncomfortable, I usually know exactly why.'
Proactive approach to health	'I take good care of my body.'
Behavioural components of health literacy	
Dealing with health information	'Information about health is often unclear to me.'
Self-control	'When working on a task, I can prevent my thoughts from constantly wandering off.'
Self-regulation	'I can easily switch between phases of high concentration and phases of relaxation.'
Communication and cooperation	'When I am not feeling well, I have no problem accepting someone's help.'

German questionnaire in Ref. [19] and translated example items from Ref. [22].

Table III. *Baseline data ($n = 495$)*

Characteristics	*WEB* ($n = 149$)	*WEB + FTF* ($n = 187$)	*CON* ($n = 159$)
Age (years), mean ± SD (min–max)	20.2 ± 1.7 (18–25)	20.9 ± 1.9 (18–25)	20.9 ± 1.9 (18–25)
Sex (female), *n* (%)	96 (64.4)	113 (60.4)	83 (52.2)
BMI (kg/m^2), mean ± SD (min–max)	23.6 ± 5.2 (15.9–59.4)	23.9 ± 4.2 (15.8–46.3)	23.9 ± 3.7 (18.0–37.8)
Health literacy dimension, mean ± SD (min–max)			
Self-perception	3.0 ± 0.4 (2–4)	3.0 ± 0.5 (1.8–4)	2.9 ± 0.5 (1.6–4)
Proactive approach to health	2.5 ± 0.6 (1–4)	2.6 ± 0.6 (1–4)	2.6 ± 0.6 (1–4)
Dealing with health information	2.7 ± 0.5 (1.2–4)	2.9 ± 0.6 (1–4)	2.8 ± 0.5 (1.4–4)
Self-control	2.8 ± 0.4 (1.8–4)	2.9 ± 0.5 (1–4)	2.8 ± 0.5 (1–4)
Self-regulation	2.7 ± 0.6 (1–4)	2.6 ± 0.7 (1–4)	2.7 ± 0.6 (1–4)
Communication and cooperation	2.7 ± 0.6 (1.25–4)	2.6 ± 0.6 (1.25–4)	2.7 ± 0.6 (1.25–4)

Valid percentages due to missing data.

73 [45.3%], *WEB + FTF*: 57 [27.7%] and *CON*: 27 [16.5%]), 375 students (70.6% of the whole sample) participated at baseline and in at least at one post-measurement.

The natural setting caused reasons for dropouts or missing data, e.g. classes following block teaching being unavailable at measurements, exam periods, school trips, shortening or cancellation of apprenticeships and sickness absenteeism.

Effectiveness

None of the study arms showed a significant improvement in any of the dimensions of health literacy compared with the control group (Table IV). All six dimensions tended to decrease in both study arms (except 'dealing with health information' in *WEB + FTF*). Significant reductions in a value range from 1 to 4 were found in *WEB* for the dimensions of 'self-perception' ($\beta = -0.131$, 99.1% CI [−0.257 to −0.004], $P = 0.007$), 'self-control' ($\beta = -0.155$, 99.1% CI [−0.287 to −0.023], $P = 0.002$) and 'communication and cooperation' ($\beta = -0.212$, 99.1% CI [−0.375 to −0.050], $P = 0.001$) and in *WEB + FTF* for the dimension of 'communication and cooperation' ($\beta = -0.170$, 99.1% CI [−0.329 to −0.010], $P = 0.005$).

Discussion

Neither the web-based platform intervention nor the combination of the web-based platform with an additional school health day before the start of the web-based intervention was more effective regarding the promotion of health literacy compared with regular school lessons following the curriculum alone.

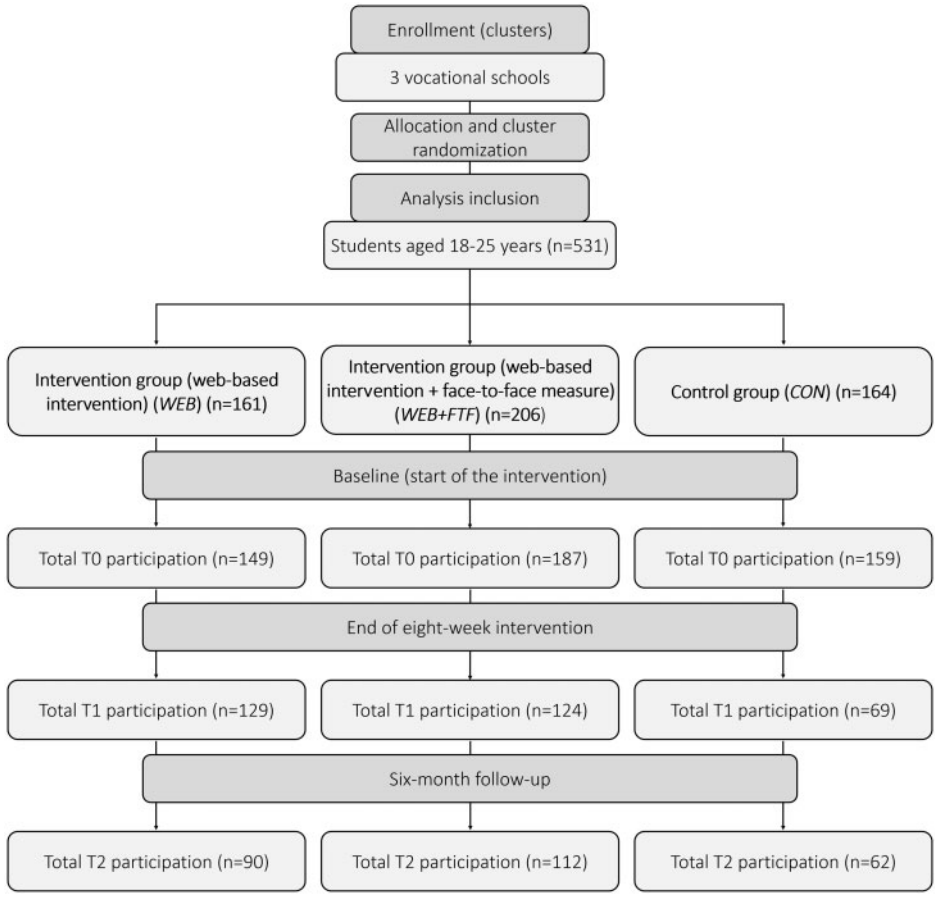

Fig. 3. Flowchart (study participation).

Although an association between health literacy and a healthy lifestyle is acknowledged [54, 55], the question arises whether lifestyle interventions are too unspecific to actually improve health literacy. Thus, questions remain whether our primary information-based approach with versatile content could promote health literacy. The single dissemination of health-related information might not necessarily be sufficient for developing and improving health literacy and sustainable behaviour change. Addressing health literacy involves more than health information transmission and knowledge improvement [56, 57]. Based on the chosen health literacy definition and model, it should be clarified how interventions could be conceptualized in a targeted manner.

The intervention's lack of effectiveness regarding the promotion of the six dimensions of the structural health literacy model is in line with a study by Fiedler *et al*. [58], who aimed to promote health literacy among IT managers through a classroom training programme. To the best of our knowledge, this is the only other longitudinal study that has used the same questionnaire to date. The study aimed at health literacy promotion through a 5-month modularized health literacy and self-management programme using classroom training, peer coaching and practice material [58]. Besides 'proactive approach to health', no significant intervention effect was observed regarding health literacy compared with the waiting list control group.

Table IV. *Results of the multi-level regression analysis for the six health literacy dimensions (control group CON as reference)*

Health literacy dimension	Coefficient β	Standard error	99.1% CI	*P*-value
Self-perception ($n = 363$)				
WEB	−0.131	0.048	(−0.257 to −0.004)	0.007[a]
WEB + FTF	−0.109	0.047	(−0.231 to 0.013)	0.020
Proactive approach to health ($n = 361$)				
WEB	−0.104	0.060	(−0.260 to 0.052)	0.081
WEB + FTF	−0.039	0.058	(−0.190 to 0.112)	0.501
Dealing with health information ($n = 359$)				
WEB	−0.011	0.052	(−0.148 to 0.125)	0.828
WEB + FTF	0.037	0.051	(−0.096 to 0.171)	0.463
Self-control ($n = 365$)				
WEB	−0.155	0.050	(−0.287 to −0.023)	0.002[a]
WEB + FTF	−0.077	0.049	(−0.206 to 0.052)	0.118
Self-regulation ($n = 365$)				
WEB	−0.125	0.055	(−0.268 to 0.018)	0.023
WEB + FTF	−0.107	0.054	(−0.231 to 0.013)	0.045
Communication and cooperation ($n = 368$)				
WEB	−0.212	0.062	(−0.375 to −0.050)	0.001[a]
WEB + FTF	−0.170	0.061	(−0.329 to −0.010)	0.005[a]

Included in the analysis are all participants with at least one post-measurement.
[a]Significant at 0.8% level.

In general, the current state of research on health literacy interventions is still relatively vague. Visscher *et al.* [59] found a huge heterogeneity in terms of study designs, measurement tools and outcomes in their review, a finding comparable with the review by Jacobs *et al.* [60] about technology-based interventions to improve health literacy. Brainard *et al.* [61] also found considerable differences regarding trial design, conduct and reporting in their methodological review of RCTs directed at health literacy. There remains a need for consensus on the definition of health literacy [59] and further intervention experimentation using suitable measurement tools [57, 59].

Apart from that, in critical phases of life such as 'emerging adulthood', interventions should target multiple health behaviours [32]. Web-based studies—e.g. those aiming at physical activity—show that structured educational materials positively moderate behaviour change [40]. Furthermore, web-based lessons targeting health promotion via cooking skills or general knowledge on nutrition and physical activity lead to long-term healthy behaviour among young adults in their late-teens and early-twenties [62, 63]. When conceptualizing future health literacy interventions for young adult target groups, one should take up promising approaches from existing health promotion interventions. Nevertheless, targeting multiple behaviours can be effective regarding the promotion of both healthy lifestyles and health literacy, and thus their components should have a coherent framework [23]. Since there are different descriptions of the concept of health literacy [48], it needs to be explored which intervention contents and components might lead to long-term health literacy improvement [59].

The potential for web-based measures to promote health literacy is still present, especially for digitally perceptive target groups. First of all, research shows that self-reported health literacy is not associated with the use of digital technology but with health-related digital use [64]. It is essential to use the advantages of the medium to create 'systems that tailor information, advice, counselling and behavioural support to an individual's need at a given time and place' [65] and counteract the digital divide [66]. Education should aim to enhance students'

eHealth literacy [67]. Blended interventions (combining face-to-face with online activities) offer potential [59]. Therefore, future research should place a stronger focus on how to link educational settings with their advantages (e.g. frequent face-to-face contact) with digital interventions. In general, education systems should place a stronger focus on providing people with individual skills to improve their health [26].

Strengths and limitations

Overall, our study includes some strengths.

The cluster RCT represents the natural setting of vocational schools with their grades. Therefore, a 'contamination' between the participants—which might have can occurred in a fully randomized trial—could be prevented by the separated schools [68]. In general, longitudinal and web-based studies aiming at health literacy remain rare [60] since most studies are correlational [59], and follow-up measurements are often lacking in both web-based [32] and health literacy studies [61]. Long-term follow-up measurements (meaning at least 6 months, as realized in our study) should be carried out as standard [69].

Furthermore, in most intervention studies, health literacy is only measured at baseline to identify subgroups with limited health literacy. Health literacy is rarely analysed pre–post as the primary outcome measure [23, 59, 60]. Since there is a lack of published studies with negative results, our study contributes to diminish the publication bias [23].

Finally, most studies targeting young adults are conducted in universities, whereby research often overlooks non-student populations [31]. Our sample is comparable with other studies and German surveys regarding baseline health literacy scores, age, sex distribution and mean BMI [19, 70, 71]. Commercial vocational training is, in general, more common among young women [72], explaining the slight shift in our sample regarding sex distribution. Therefore, our study has an added value regarding the heterogeneous target group of young adults and health-promoting measures outside universities and colleges.

However, the findings of this study have to be seen in the light of some limitations.

The chosen questionnaire is not yet established in international research, which makes it difficult to compare our findings with other studies. Nevertheless, Lenartz's health literacy questionnaire provides insights into different individual competencies within a structured model [22]. Selecting questionnaires in health literacy research remains difficult since there are differences regarding the definition and operationalization of the concept [73–75]. The high dropout across the measurements underlines the challenges of rigorous study designs in natural settings [61] and calls for better communication and coordination between researchers and practitioners.

Conclusions

In the current study, a web-based intervention was not effective regarding the improvement of individual competencies within a structural model of health literacy among vocational school students. More than the transmission of information is needed to improve health literacy [56]. Future research must examine how to build up target-oriented interventions.

The aim of educational institutions should not only be to teach young people but also to enable them to deal with their health and make health-related decisions as health literate citizens [17, 48]. In light of today's media use, digital interventions in educational settings offer strong potential. Researchers and practitioners should aim to link the upsides of both aspects, namely personal face-to-face contact and digital progress.

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Conflict of interest statement

None declared.

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