Fakultät Wissenschaftszentrum Weihenstephan für Ernährung, Landnutzung und Umwelt

Serious Games for Nutritional Education in Children, Adolescents, and Young Adults: Surveys, Development, and Evaluation

Sophie Laura Holzmann

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„Denn, um es endlich auf einmal herauszusagen, der Mensch spielt nur, wo er in voller Bedeutung des Worts Mensch ist, und er ist nur da ganz Mensch, wo er spielt."

Friedrich Schiller

Über die ästhetische Erziehung des Menschen

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Abstract

The rising trends in overweight and obesity worldwide have evolved into a public health concern. One possible cause for this development is the *obesogenic environment*, which is characterised by a ubiquitous availability and an increased consumption of energy-dense foods and beverages. To address this health challenge, primary prevention programmes, such as nutritional education, can be applied among younger age groups (*children and adolescents*, and *young adults*) to avoid early weight gain. Besides traditional education methods (e.g. classroom teaching), digital approaches (e.g. *serious games*) are available.

The aim of this thesis was to conduct surveys among *children and adolescents* and *young adults* to assess their preferences, motives, needs, and behaviour regarding a *serious game* for nutritional education. Based on the survey findings, a *serious game* prototype*, Fit, Food, Fun,* was developed by an interdisciplinary research group for the target group of *children and adolescents*. A one-week pilot study was then conducted among secondary school students in Bavaria to investigate whether the *Fit, Food, Fun* game was effective in imparting nutritional knowledge.

The surveys among 293 *children and adolescents* (secondary schools, 7th to 8th grade) and 468 *young adults* (primarily universities) revealed that both target groups play digital games (86 % versus 63 %) and are also interested in nutritional education via *serious games* (51 % versus 73 %). The one-week pilot study among Bavarian secondary school students was aimed to compare a digital nutritional education by gameplay (*Fit, Food, Fun* game, N = 39) against a traditional teaching approach (classroom teaching, N = 44). The study revealed that both educational interventions significantly improved nutritional knowledge ($p = 0.001$ versus $p < 0.0001$). The between-group comparison showed that the classroom teaching group improved nutritional knowledge significantly more than the digital gameplay group ($p = 0.01$).

The findings of this thesis show that *children and adolescents* as well as *young adults* play digital games and are also interested in nutritional education using *serious games*. Therefore, the *Fit, Food, Fun* game might be an efficient and appropriate tool to impart nutritional knowledge to *children and adolescents*. However, to determine the extent to which the *Fit, Food, Fun* game is effective and to derive recommendations for action, long-term studies with larger and more diverse groups are indispensable. In addition, it remains to be assessed whether an improvement in nutritional knowledge can affect changes in dietary behaviour.

Zusammenfassung

Übergewicht und Adipositas haben sich weltweit zu einem Risiko für die öffentliche Gesundheit entwickelt. Eine mögliche Ursache für diese Entwicklung ist die *adipogene Umwelt*, die insbesondere von der ubiquitären Verfügbarkeit und dem erhöhten Konsum von energiedichten Lebensmitteln und Getränken geprägt ist. Primärpräventive Ansätze (z.B. Ernährungsbildung), können bei *Kindern und Jugendlichen* sowie *jungen Erwachsenen* angewandt werden, um einer frühen Gewichtszunahme vorzubeugen. Neben den traditionellen Bildungsmethoden gibt es auch digitale Ansätze, wie zum Beispiel der Einsatz von *serious games*.

Das Ziel der vorliegenden Dissertation war es, Befragungen bei *Kindern und Jugendlichen* und bei *jungen Erwachsenen* durchzuführen, um die beiden Zielgruppen hinsichtlich ihrer Präferenzen, Motive und Bedürfnisse sowie ihres Spielverhaltens zu charakterisieren. Auf Grundlage der Befragungsergebnisse wurde in interdisziplinärer Zusammenarbeit der *serious game* Prototyp *Fit, Food, Fun* für die Zielgruppe *Kinder und Jugendliche* entwickelt. Ferner wurde in einer Pilotstudie untersucht, ob sich das Ernährungswissen bei *Kindern und Jugendlichen* durch den Einsatz des *Fit, Food, Fun* Spiels verbessert.

Die Befragungen bei 293 *Kindern und Jugendlichen* (Mittelschulen, 7. und 8. Klasse) und 468 *jungen Erwachsenen* (primär Universitäten) ergab, dass beide Zielgruppen digitale Spiele spielen (86 % versus 63 %) und Interesse an digitaler Ernährungsbildung durch *serious games* (51 % versus 73 %) haben. Im Rahmen einer einwöchigen Pilotstudie an Bayerischen Mittelschulen wurde das *Fit, Food, Fun* Spiel (N = 44) mit einem klassischen Frontalunterricht (N = 39) im Hinblick auf die Vermittlung von Ernährungswissen verglichen. Es konnte gezeigt werden, dass beide Ernährungsbildungsinterventionen das Ernährungswissen von *Kindern und Jugendlichen* signifikant ($p = 0.001$ versus $p < 0.0001$) verbessert haben. Zudem hat der Vergleich zwischen den beiden Interventionsgruppen ergeben, dass die Gruppe, die den Frontalunterricht erhalten hatte, signifikant ($p = 0.01$) mehr Ernährungswissen erworben hat als die Gruppe, die das *Fit, Food, Fun* Spiel gespielt hat.

Zusammengefasst konnte gezeigt werden, dass *Kinder, Jugendliche* und *junge Erwachsene* digitale Spiele spielen und Informationen über Ernährung in einem digitalen Spiel erhalten möchten. Das *Fit, Food, Fun* Spiel kann als eine effiziente und geeignete Methode für die Ernährungsbildung bei *Kindern und Jugendlichen* angesehen werden. Für eine abschließende Bewertung der Effektivität des *Fit, Food, Fun* Spiels sowie der Ableitung von Handlungsempfehlungen sind Langzeitstudien mit einem größeren und diverseren Kollektiv unabdingbar. Zudem sollte getestet werden, inwiefern eine Verbesserung des Ernährungswissens auch eine Veränderung des Ernährungsverhaltens bedingt.

Abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
AGA	German Working Group of Obesity in Childhood and Adolescence
AHG	Alien Health Game
ANGELO	Analysis Grid for Environments Linked to Obesity
app	Application
BLS	The German Nutrient Data Base
BMI	Body Mass Index
DEGS	German Health Interview and Examination Survey for Adults
DGE	German Society of Nutrition e. V.
DIAB	Escape from Diab
DONALD	Dortmund Nutritional and Anthropometric Longitudinally Designed
DSM	Diagnostic and Statistical Manual of Mental Disorders
e.g.	*Exempli gratia*
FFF	Fit, Food, Fun
FFQ	Food Frequency Questionnaire
g	Gram(s)
GG	Gameplay Intervention Group
hr	Hour(s)
ICD	International Statistical Classification of Diseases and Related Health Problems
ICT	Information and Communication Technology
kcal	Kilocalorie(s)
kg	Kilogram(s)
KiGGS	German Health Interview and Examination Survey for Children and Adolescents
LMU	Ludwig-Maximilians-University
m	Meter(s)
METs	Metabolic Equivalents
min	Minute(s)
ml	Millilitre(s)
NANO	Nanosworm: Invasion from Inner space
NVS II	German National Food Consumption Survey II
OMD	Optimised Mixed Diet
PC	Personal Computer
QR	Quick Response
QTLM	Quest to Lava Mountain
RCT	Randomised Controlled Trial
SCT	Social Cognitive Theory
SS	Super Shopper
SSB	Sugar-Sweetened Beverages
TG	Teaching Intervention Group
TUM	Technical University of Munich
US	United States
vs	Versus
WHO	World Health Organization
yrs	Years

1. Introduction

1.1 Overweight and Obesity

Worldwide, the prevalence of overweight and obesity is a major public health concern [1]. Within the past 40 years (yrs) (1975 to 2016), the prevalence of obesity among *children and adolescents* aged five to 19 yrs increased tenfold (11 to 124 million), with additional 213 million *children and adolescents* being affected by overweight [2]. In Germany, the prevalence of overweight and obesity among *children and adolescents* aged three to 17 yrs is 15.4 %, respectively 5.9 % [3]. However, there is evidence for the assumption that the prevalence of overweight and obesity in the younger population has recently stabilised at a high level [3,4]. Besides childhood and youth, the prevalence of overweight and obesity increases continually with age [5]. Therefore, an early detection and continuous monitoring of the weight status is indicated to prevent weight gain in the short-term and the development of overweight and obesity in the long-term. The weight status of *children and adolescents* can be assessed using the *body mass index* (BMI) *z*-scores or percentiles [6]. The BMI (kg/m^2), a *measure of weight adjusted for height* [6], is defined as the weight in kilograms (kg) divided by the square of height in meters (m). Therefore, the BMI is calculated first and compared with *z*-scores or percentiles afterwards [6,7]. In Germany, the *German Working Group of Obesity in Childhood and Adolescence* (AGA) recommends to use predefined BMI reference curves (percentiles) for the assessment of *children's and adolescents'* weight status [8]. **Table 1** gives an overview about the BMI percentiles for each weight status according to AGA.

Table 1. Classification of Weight Status by BMI Percentiles for *Children and Adolescents* (AGA) [8].

BMI Percentile	**Weight Status**
< 10	Underweight
10 - 90	Normal weight
> 90 - 97	Overweight
> 97 - 99.5	Obesity
> 99.5	Severe Obesity

AGA = *German Working Group of Obesity in Childhood and Adolescence*, BMI = *body mass index*.

Besides *children and adolescents*, *young adults* also represent a vulnerable group for the development of overweight and obesity. According to the *German Health Interview and Examination Survey for Adults* (DEGS1, 2008 to 2011), a representative survey among more than 8.000 German adults, the prevalence of overweight among *young adults* (18 to 29 yrs) is 35.3 % in men and 30.0 % in women [5]. Close to 10 % (9.6 %) of young women and more than 5 % (6.6 %) of young men are affected by obesity with increasing trends in later life [5]. However, in Germany, the overall prevalence of overweight / obesity is 67.1 % / 23.3 % among men and 53.0 % / 23.9 % among women [5].

In contrast to the gender and age specific weight assessment among *children and adolescents*, the *World Health Organization* (WHO) recommends to categorise adults' weight status using the BMI only [9]. **Table 2** shows the different BMI categories, the respective weight status classification, and the risk of comorbidities for adults over 20 yrs old [9]. Accordingly, overweight is defined as a BMI greater than or equal to 25.00 kg/m^2 and obesity is diagnosed with a BMI greater than or equal to 30.00 kg/m^2 [9].

Table 2. Classification of Weight Status by BMI for Adults (WHO) [9].

BMI [kg/m^2]	**Weight Status**	**Risk of Comorbidities**
< 18.50	Underweight	Low
18.50 - 24.99	Normal weight	Average
≥ 25.00	Overweight	
25.00 - 29.99	*Pre-obesity*	*Increased*
30.00 - 34.99	*Obesity class I*	*Moderate*
35.00 - 39.99	*Obesity class II*	*Severe*
≥ 40.00	*Obesity class III*	*Very severe*

BMI = *body mass index*, kg = kilogram, m = meter.

The BMI is the most commonly used measure to assess overweight and obesity among adults, although it has limitations, e.g. no distinction between age, sex, and body composition [6,9]. The primary cause for overweight and obesity is a positive energy balance, caused by an increase in calories consumed and a decrease in calories expended and favoured by a weight-promotive environment [1]. The so-called *obesogenic environment* [10] can be characterised by a variety of micro- and macro-

environmental factors [11]. **Figure 1** gives an overview about selective variables, which are characteristic for an *obesogenic environment*.

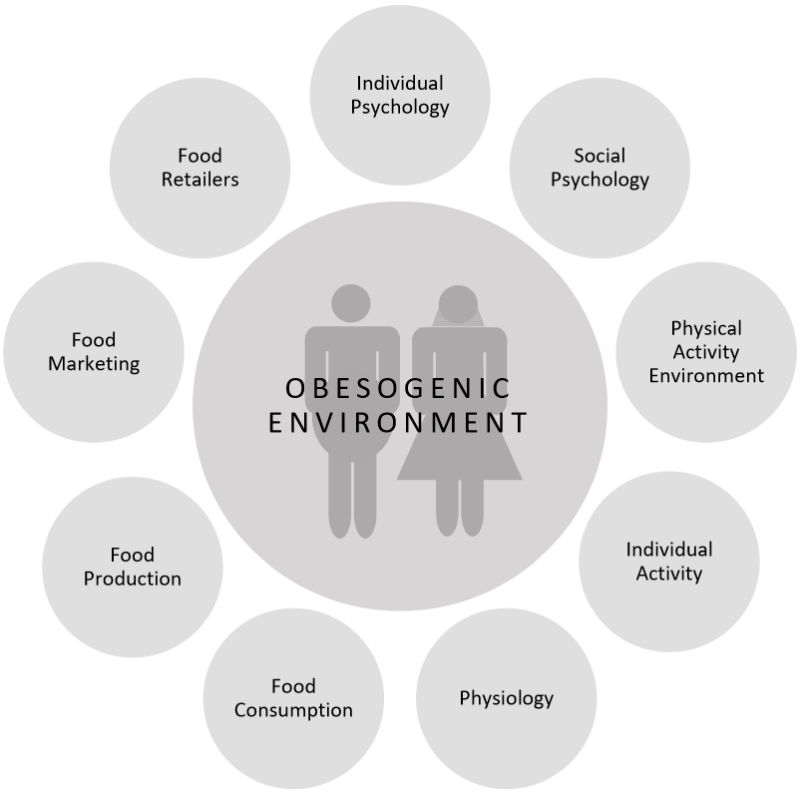

Figure 1. Selective Overview about Characteristics of *Obesogenic Environments* [12].

Overweight and obesity are favoured by a ubiquitous availability and intake of energy-dense and micronutrient-poor foods, as well as sugar sweetened beverages (SSB), combined with increased levels of physical inactivity and sedentary behaviours [10,13]. Furthermore, parents as the *home's nutritional gatekeepers* can impact the children´s weight status by influencing their food choices [14–16]. According to surveys among more than 1,700 nutrition educators and parents, it was estimated that *nutritional gatekeepers* determine more than 72 % of their child´s diet [14]. Moreover, *children's and adolescents'* sports activities were associated with their parents' sports activities and activity-friendly living environments [17]. Besides parents, also peers and friends have an influence on *children's and adolescents'* dietary behaviours [18]. There is evidence that weight based similarities can affect friendship selection among adolescents [18,19]. A study among more than 600 adolescents (12 to 14 yrs) revealed that participants with overweight are twice as likely to have friends, who are also affected by overweight [20]. This social principle is called *homophily*, which states that similarities of individuals within social networks, e.g. friendships, create interpersonal connections and relationships [21]. Consequently, personal networks are considered as homogeneous regarding socio-demographic, behavioural, and intrapersonal characteristics [21]. Moreover, there is evidence that peers and friends

also have an impact on *children's and adolescents'* activity behaviours [18]. However, besides the previously mentioned lifestyle risk factors, there are also several physiological, psychological, epigenetic, and genetic factors, which are involved in the development of overweight and obesity among *children and adolescents* and *young adults*.

1.2 Lifestyle Behaviours — Diet and Physical Activity

Dietary behaviour and physical activity are the main determinants of the onset of overweight and obesity across all age groups and life stages. In Germany, most *children and adolescents* and *young adults* do not meet the dietary and physical activity requirements for a healthy lifestyle [17,22,23]. With respect to the development of weight, the intake of SSB, sweets, and sweet spreads is considered as weight-promotive, while the consumption of water, fruits, and vegetables is considered as weight-protective. According to data of the *German Health Interview and Examination Survey for Children and Adolescents Wave 2* (KiGGS 2; 2014 to 2017), about 16.9 % of girls and 22.2 % of boys consume SSB at least once a day [24]. Compared to girls, boys at the same age show on average a higher consumption of SSB [25]. The average intake of SSB among three to 17-year-olds is more than 500 millilitres (ml) per day, which approximately corresponds to a quantity of two glasses [24,25]. For instance, one can (330 ml) of SSB (e.g., soda) contains approximately 150 kilocalories (kcal) and 40 to 50 grams (g) of sugar. Assumed that this energy value would be added to the daily diet, it could result in a weight gain of about 6.75 kg within one year [26]. According to the recommendations of the *Optimised Mixed Diet* (OMD), a maximum of one glass (200 ml) of lemonade per day is tolerated. However, *children and adolescents* are recommended to mainly drink energy-free (water, unsweetened teas) or low-energy (strong diluted juice spritzers) beverages [27–30]. Besides the recommendations for a healthy lifestyle, there is also a need to educate individuals on the risks of SSB and to reduce their availability and distribution [29,30]. However, positive changes were observed for SSB intake among *children and adolescents* within the past decade – the consumption of SSB decreased and the intake of water increased [24]. Compared to the *KiGGS Baseline Study* (2003 to 2006), the daily consumption of SSB decreased significantly by about one-fourth among *children and adolescents* [17]. Moreover, there is evidence that the frequency of SSB consumption rises with increasing age [24].

According to DEGS1, there is also a high prevention potential regarding the consumption of SSB in *young adults* [25]. In accordance with data among *children and adolescents*, *young adults* consume more SSB than recommended by German nutrition and obesity societies – on average more than two glasses of SSB each day [25]. However, the SSB consumption of adults is decreasing by the age of 30 yrs [25]. This also applies for the consumption of free sugars. According to the *German National Food Consumption Survey* (NVS II) among age groups between 14 and 80 yrs, adolescents (14 to 18 yrs) and

young adults (19 to 24 yrs) are the age groups with the highest intake of free sugars [30]. The *Dortmund Nutritional and Anthropometric Longitudinally Designed* (DONALD) study showed that the estimated intake of free sugars (percentage of total energy intake) is 16.7 %, respectively 16.9 % among girls and boys (11 to 14 yrs) [30]. According to the NVS II, the estimated intake of free sugars (percentage of total energy intake) in *young adults* (19 to 24 yrs) is 18.5 % (women) and 16.2 % (men) [30]. The WHO recommends that the intake of free sugar should not exceed 10 % of total energy intake [31], which is also recommended by German nutrition and obesity societies [30]. Finally, the WHO suggests to further diminish the free sugar intake to less than 5 % of total energy intake [31]. This emphasises that the age groups of *children and adolescents* and *young adults* are vulnerable for a high consumption of free sugar and therefore also for weight gain in the long-term [30].

Besides the intake of foods and beverages, which favour weight gain (e.g. SSB, sweets), the recommended intake of other foods and beverages (e.g. vegetables, water) is considered as protective against the onset of overweight and obesity. By now, the consumption of healthy nutrients or foods decreases and is below the existing recommendations. For instance, German *children and adolescents* (3 to 17 yrs) consume about 250 g fruits and 125 g vegetables on average each day [17], which is below the OMD recommendations [27,28]. Compared to data from the *KiGGS Baseline Study*, the current consumption of vegetables, especially among eleven- to 17-year olds, decreased significantly within the past ten years [17]. Moreover, only 14.1 % of *children and adolescents* (3 to 17 yrs) meet the *5-a-day* recommendation for the consumption of fruits and vegetables [17]. According to DEGS1, *young adults* (18 to 29 yrs) do not comply with the *5-a-day* recommendation as well [22]. More precisely, young women consume on average 2.8 portions of fruits and vegetables each day, whereby young men consume on average 2.0 portions. Approximately 13.8 % of young women and 5.0 % of young men follow the *5-a-day recommendations* and eat five or more portions of fruits and vegetables daily [22]. Accordingly, the consumption of fruits and vegetables in *young adults* is below the general recommendations and should be addressed within respective prevention and treatment programs.

Taken together, the current data demonstrate that lifestyle behaviours (diet and physical activity) in *children and adolescents* and *young adults* do not meet the existing recommendations of nutrition and obesity societies and, therefore, are at risk for the development of specific diseases. For instance, a high intake of sugar by, e.g. SSB is associated with the development of overweight and obesity and the onset of associated comorbidities, e.g. *Type 2 Diabetes*, *Cardiovascular Diseases*, and *Dental Caries*, especially at younger life years [32]. Therefore, there is a need for (novel) overweight and obesity prevention and treatment strategies (e.g. nutritional education) addressing this health challenge.

1.3 Nutritional Education – Traditional Approaches

1.3.1 Definition of Nutritional Education

Nutritional education is defined as the individual's effort to establish a personally meaningful diet through a healthy lifestyle, in which the individual experiences support and empowerment [33]. Nutritional education is not limited to the correction and development of the individual's behaviour, but also addresses social, ecological, and economic aspects of a self-determined and co-responsible human acting [33]. This definition demonstrates that nutritional education needs to be understood as a holistic approach and requires to address not only the behaviour itself, but also the individual's environment (e.g. parents, friends, teachers) [34].

1.3.2 Nutritional Education by Parents and Families

The experiences and educational processes in the individual's early stages of life shape its health-related lifestyle behaviours in later life [33,34]. The family (e.g. parents) represents a main educational determinant for the dietary behaviour among the younger population [34]. Therefore, also parents represent a target group for nutritional education and behaviour interventions [35]. The literature indicates that parents as the family's nutritional gatekeeper directly or indirectly affect 72 % of the dietary intake of their children, named the *72% solution* [14]. Moreover, *children's and adolescents'* dietary behaviour is affected by the *obesogenicity of modern environments* [11], which contributes to weight gain among this age group (**see 1.1**) [36]. According to the *Analysis Grid for Environments Linked to Obesity* (ANGELO) framework, the environment is characterised by size (micro and macro) [11]. Moreover, the influencing factors on dietary behaviour and physical activity are classified as *obesogenic* or *leptogenic* [11]. Accordingly, parents are seen as a key determinant of children's microenvironments [36]. A narrative review indicates that the micro-environmental home setting (parental dietary behaviour and diet-related parenting practices) affects *children's and adolescents'* food environment, dietary behaviour, and BMI [36]. There is also evidence by a systematic review and meta-analysis for a parent-child correspondence with respect to dietary behaviours [37]. *Touyz et al.* (2018) performed a systematic review and meta-analysis on the effectiveness of parent-targeted in-home interventions for the improvement of fruits and vegetable intake in children (2 to 12 yrs) [35]. This meta-analysis revealed that parent-targeted nutritional education interventions induced a significantly increase in the intake of fruits but had a small effect size (Hedges' $g = 0.112$, $p = 0.028$). A moderate effect was found for interventions on taste exposure, which significantly increased vegetable intake (Hedges' $g = 0.438$, $p < 0.001$) [35]. Moreover, it was acknowledged that the delivery frequency of interventions plays a role, since, compared to monthly sessions, daily or weekly sessions were more effective [35].

1.3.3 Nutritional Education by Schools and Universities

Across ***childhood and youth***, schools are another mediator of nutritional education, since imparting of nutritional knowledge is part of several curricula in Germany [34]. *Dudley et al.* (2015) conducted a systematic review and meta-analysis on single- and multi-component school-based teaching approaches and strategies for healthy eating in primary school children [38]. Besides conventional teaching programs, game- (board games, card games) and web-based (e.g. internet) interventions were included as well [38]. In total, data of around 40,000 primary school children (49 studies, 13 countries) were analysed. Taken together, most teaching interventions promoted positive changes in dietary behaviour among children. Experiential learning strategies (e.g. *school/community garden, cooking and food preparation activities*) were most effective regarding the positive changes in dietary behaviour outcomes (e.g. decreased energy intake, increased fruits and vegetable intake) and improvements in nutritional knowledge [38]. Cross-curricular approaches (e.g. *nutrition education programs that were delivered across two or more traditional primary school subjects*) induced the main positive effects on sugar consumption [38]. The impact of single- and multi-component school-based interventions on daily fruits and vegetable intake among more than 26,000 children (5 to 12 yrs) was evaluated by a further systematic review and meta-analysis [39]. In total, the 21 studies showed that school-based dietary programs, which also included one computer game intervention [40], improved fruit intake (fruit juice excluded) by 0.24 portions (95% CI: 0.05, 0.43 portions) ($p = 0.01$) and vegetable intake (fruit juice included) by 0.07 portions (95% CI: -0.03, 0.16 portions) ($p = 0.16$) [39]. Another systematic review and meta-analysis assessed the effectiveness of school-based interventions with respect to fruits and vegetable consumption among primary school children (5 to 12 yrs) and showed that computer-based interventions are effective in the promotion of fruits and vegetables, whereas no significant differences were detected for multi-component interventions or free/subsidised programs for the promotion of fruits and vegetables [41]. Finally, a recent publication investigated the long-term effects of a multi-component school-based educational intervention on fruits and vegetable intake (e.g. classroom curriculum, parental involvement, free school fruits) among sixth- and seventh-graders (10 to 12 yrs) compared to control schools [42]. After 14 yrs, no significant differences in fruits and vegetable intake were detected [42].

While schools are a frequently used setting for educational interventions among *children and adolescents*, interventions for ***young adults*** are often applied in the university environment [43,44]. There are a variety of educational programs and interventions on nutrition with different purposes [45,46]. Since the comprehension of nutritional information on food labels is deficient [47], especially in *young adults* [48], there is ongoing research in this field. Nutrition labels are perceived as a reliable source for nutritional information and are used across all age groups [47]. The use of nutrition facts

label and its association with diet quality was investigated within a cross-sectional study among 958 university students (18 to 34 yrs). It was shown that the quality of dietary intake, assessed by the *Healthy Eating Index-2005*, was significantly associated with the use of information on nutrition facts label ($p < 0.001$) [43]. The nutrition labelling approach provides a cost-effective educational intervention at the population level [47]. Moreover, literature indicates that educational interventions should cover both individual level and population based approaches [49]. However, there is a lack in high-quality research and scientific evidence among *young adults* in this field [49].

1.4 Nutritional Education – Novel Approaches

Obesity and overweight prevention and treatment strategies at the individual and the population level are often affected by limited effectiveness [1]. Consequently, novel prevention strategies, such as ***nutritional nudging*** have become increasingly popular [50]. Besides that, the digitalisation of prevention and treatment approaches gained interest. Researchers can rely on a variety of ***new Information and Communication Technologies*** (ICTs), e.g. *smartphone applications* (*apps*) and *wearables* to deliver interventions (e.g. lifestyle) digitally or digitally-supported [51]. Accordingly, today's population uses digital tools for health purposes [52]. For instance, ***apps* and *wearables*** are applied for a variety of purposes like self-monitoring and -tracking of diet, physical activity, weight, sleep, and vital functions. The scientific evidence of the effectivity of *apps* and *wearables* regarding weight management is rather inconsistent, although some intervention studies have shown significant changes [51]. Besides the lack in high-quality and long-term intervention studies, there are limitations regarding the development and evaluation of *apps* and *wearables* [51,53]. However, current research may benefit from the use of new ICTs as they are considered to be ubiquitous available, time and cost effective, scalable, and easily accessible [54–57]. Besides *apps* and *wearables*, a further intervention approach are digital games for serious purposes, which are known as ***serious games***.

1.5 Digital Games for Serious Purposes – *Serious Games*

Games and gameplay have a long history. A novel human image - besides the *homo sapiens* and the *homo faber* – was coined by *Johan Huizinga* (1872 - 1945), a Dutch historian, who considers the human being as a gaming individual (***homo ludens***) and conceives the origin of culture in the game (*homo ludens - a study of the play-element in culture*, published in 1949) [58]. This shows that gaming itself has already attracted attention in former times and is not a phenomenon of the present. Within the digital age, (serious) gameplay has been digitalised. A *serious game* is a digital game that intents both to educate and to entertain, termed as ***edutainment*** [59]. Therefore, *serious games* have an

intrinsically motivating, entertaining, and engaging character [60]. This was already recognised and postulated by *Huizinga* with the following paragraph: *Here, then, we have the first main characteristic of play: that it is free, is in fact freedom. A second characteristic is closely connected with this, namely, that play is not "ordinary" or "real" life. It is rather a stepping out of "real" life into a temporary sphere of activity with a disposition all of its own. Every child knows perfectly well that he is "only pretending", or that it was "only for fun".* [58].

The **global market** for *serious games* shows increasing trends. While the market was valued with $2,731 million in 2016, it is forecasted to reach more than $9,167 million by 2023, dominated by key players like *BreakAway, Ltd., IBM Corporation, Learning Nexus Ltd, and Nintendo Co., Ltd.* [61]. *Serious games* enable users to take on the role of an *invisible actor* (**roleplay**) within the gameplay [62]. The phenomenon that players perceive being part of the game environment, is called **immersion** [60]. There are different terms for *serious games* in the context of health-promotion, like *exergames* or *games for health* [63]. ***Exergames*** (*exercise* and *games*) or *active video games* are digital games that intend to induce real body movements, in order to increase user's physical activity [64]. Moreover, ***games for health*** is the term for health-promoting games, which do not address exercising. Furthermore, there are various models for the **categorisation** of (serious) games. For instance, *Herz* suggests the following eight types of games: *Action*, *Adventure*, *Fighting*, *Puzzle*, *Role-play*, *Simulation*, *Sports*, and *Strategy* [65], while *Poole* proposes nine genres (including overlaps): *Shooter, Racing, Beat'em up, Strategy, Platform, Sport and Simulations, Adventure, Role-play*, and *Puzzle* [66]. Besides the previously mentioned genre purisms, most current games are *hybrids*, which combine elements of different genres. New games are released constantly with no specific genre name available yet. Finally, there is no unique standard categorisation of games, which allows *serious games'* stakeholders to work with different categorisations.

There are many ways (**platforms**) to play digital games, e.g. on computers (offline), consoles, tablets, handhelds, and smartphones. According to the *Annual Report of the German Games Industry* (2018), the most used games platforms in Germany are smartphones (18.2 million), PCs (17.3 million), and consoles (16.0 million), while 11.5 million of the German population uses tablets and 6.7 million handhelds for digital gameplay [67]. Moreover, there are rising trends for the number and the age of the German gaming population. Between 2013 and 2018 the number of computer and video gamers increased from 31.4 to 34.3 million. The average age of the gaming population has risen from 32.0 yrs in 2013 to 36.1 yrs in 2018 [67]. *Serious games for health* can be applied for a variety of **purposes** (e.g. prevention, therapy) and health (e.g. lifestyle behaviours) or medical conditions (e.g. obesity, Alzheimer) across all age groups (**Figure 2**).

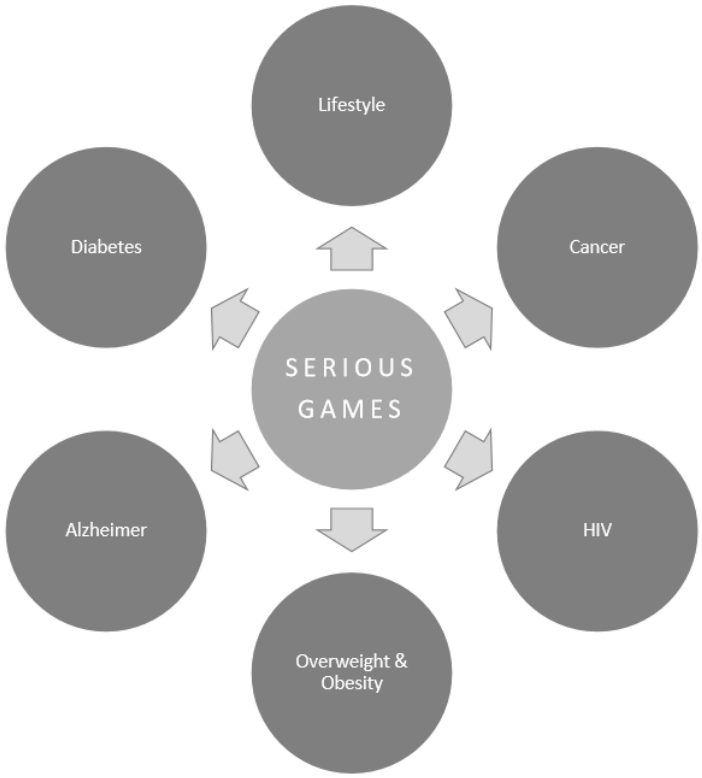

Figure 2. Application of *Serious Games* for selected Prevention and Treatment Approaches.

While some *serious games* focus on **primary and secondary prevention** of medical conditions, e.g. education for *HIV* [68,69], *Diabetes* [70], and *Cancer* [69,71], others address the **tertiary prevention**, e.g. cognitive training for patients affected by Alzheimer's disease [72]. Besides that, there are *serious games* for the promotion of a healthy lifestyle across all **age groups**. According to a meta-analysis of 54 *serious games* studies for a healthy lifestyle promotion, children (≤ 12 yrs) are the most frequent target group (57 %), followed by adolescents (13 to 18 yrs, 34 %) and (young) adults (19 to 65 yrs, 30 %), while elderly people (> 65 yrs) account for a minor proportion (2 %) [73]. Besides physical activity, cognitive and social activity, alcohol consumption, and smoking, the diet/nutrition is one of the five major and potentially modifiable lifestyle factors [74]. Within *serious games*, different nutrition-related **topics** can be addressed. There is some evidence that *serious games* can be effective in lifestyle promotion across all age groups [73], but rather less is known about their effectiveness on nutritional education among *children and adolescents* and *young adults*. Therefore, the focus of this work was to address both target groups in the context of a *serious game* for nutritional education.

1.6 *Serious Games* for Nutritional Education

The scope of *serious games* for nutritional purposes extends from imparting nutritional knowledge, influencing dietary behaviours (e.g. fruits and vegetable consumption), to the combination of both outcomes (nutritional knowledge → dietary behaviour), and to weight-related outcomes (e.g. BMI). While previous research was mainly conducted with computer or video games, tools of the current research are also *apps* for tablets and smartphones. By now, there is some evidence for the effectiveness of *serious games* on nutrition-related outcomes among *children and adolescents*. The video games ***Escape from Diab* (DIAB)** and ***Nanosworm: Invasion from Inner space* (NANO)** were developed by an interdisciplinary team of experts (nutrition, physical activity, video games) [70,75]. Moreover, quantitative and qualitative methods (e.g. surveys, focus groups) were applied to assess children's preferences during the game development [70,75,76]. The goal of both mini-games is to educate children on diet, physical activity, energy balance, and obesity to change health-related behaviours and to lower the risk for *Type 2 Diabetes* [70]. Intervention studies investigated the effectiveness of both video games on nutrition-related outcomes and diseases [70,77]. According to a randomised controlled trial (RCT) by *Baranowski et al.* (2011), children (10 to 12 yrs), who played DIAB and NANO (N = 93) significantly increased ($p < 0.018$) their fruits and vegetable consumption by 0.7 portions per day at two months post-game compared to controls (N = 40), who played web-based knowledge games [70]. Besides that, no changes in water intake, physical activity, and anthropometric measures (e.g. BMI percentile, waist circumference) were detected [70]. Another RCT by *Baranowski et al.* (2003) investigated the effects of the multimedia video game ***Squire's Quest!*** on dietary behaviours (fruits, vegetables, and juice consumption) in 1,500 fourth-grade elementary students (8 to 12 yrs) for five weeks [40]. Playing ten sessions (à 25 minutes (min)) of *Squire's Quest!* within five weeks increased the consumption of fruits, vegetables, and juice by a mean of 1.0 servings per day, compared to baseline and to no-intervention-controls [40]. The ***Quest to Lava Mountain* (QTLM)** is a web-based adventure video game designed for children aged from eight to twelve yrs. *Sharma et al.* (2015) investigated the effect of QTLM on dietary behaviours among 94 4th and 5th grade elementary school children (9 to 11 yrs) for six weeks within a pilot RCT [78]. Compared to controls, the exposure to QTLM (on average 4.6 hours (hr) for 6 weeks) resulted in a significantly ($p = 0.021$) decreased sugar consumption from pre- to post-intervention. Besides that, the intervention showed no statistically significant effect on other dietary behaviours (e.g. fruits and vegetables, dietary fibre, carbohydrates, protein, fat) [78]. Moreover, the ***FIT Game III*** [79] and the ***5 a day game*** [80] were also applied as educational interventions among primary school children aged five to eleven yrs [79] and eight to ten yrs [80] and showed positive effects on children's dietary behaviours (fruits, vegetable intake). Besides the aforementioned studies, which primarily address the effects of *serious games* on dietary behaviour

change, there is also research regarding *serious games* and nutritional knowledge [81]. *Hermans et al.* (2018) examined the short-term effectiveness of the ***Alien Health Game* (AHG)** among 58 primary school students (mean age of 11.5 yrs) against 50 controls (mean age of 11.3 yrs), playing ***Super Shopper* (SS)**, a web-based nutritional game [81]. Both interventions were applied at two consecutive days for one hour of daily gameplay. Compared to children in the SS group, children of the AHG group significantly improved ($p < 0.001$) nutritional knowledge about macronutrients from pre- to post-intervention. This effect did not persist for the follow-up period after two weeks [81]. Finally, no changes in dietary behaviour were found in both intervention groups [81].

In accordance with *children and adolescents*, there is preliminary evidence of the effects of *serious games* on nutritional education among ***young adults*** [82]. A few studies showed that *serious games* (computer, web), significantly increased nutritional knowledge in *young adults,* primarily college students [83–86]. Although some studies showed positive changes of *serious games* on nutritional knowledge, the statistical evaluation of their effects is often not performed [82,87]. In addition, there is a lack in the scientific evaluation of game-based nutritional interventions by high-quality and long-term studies among *young adults* (18 to 35 yrs) [82]. On the one hand, the interest in research on *serious games for health* has increased during recent years. On the other hand, the design, development, and evaluation of *serious games* often lack multidisciplinary scientific involvement and expertise. However, only a few *serious games* for nutrition-related purposes are available in Germany.

2. Aim

Serious games are digital games for educational purposes (e.g. nutrition) and can be applied among *children*, *adolescents*, and *young adults*. By now, *serious games* are often designed without scientific involvement and without consideration of the target group's requirements. Moreover, many *serious games* lack evidence-based evaluation. In Germany, the availability of *serious games* for nutritional education is rather limited. The primary aims of this work were to conduct surveys and to design, develop, and to evaluate a *serious game* for nutritional education. The following three main research steps were conducted to achieve these aims (**Figure 3**).

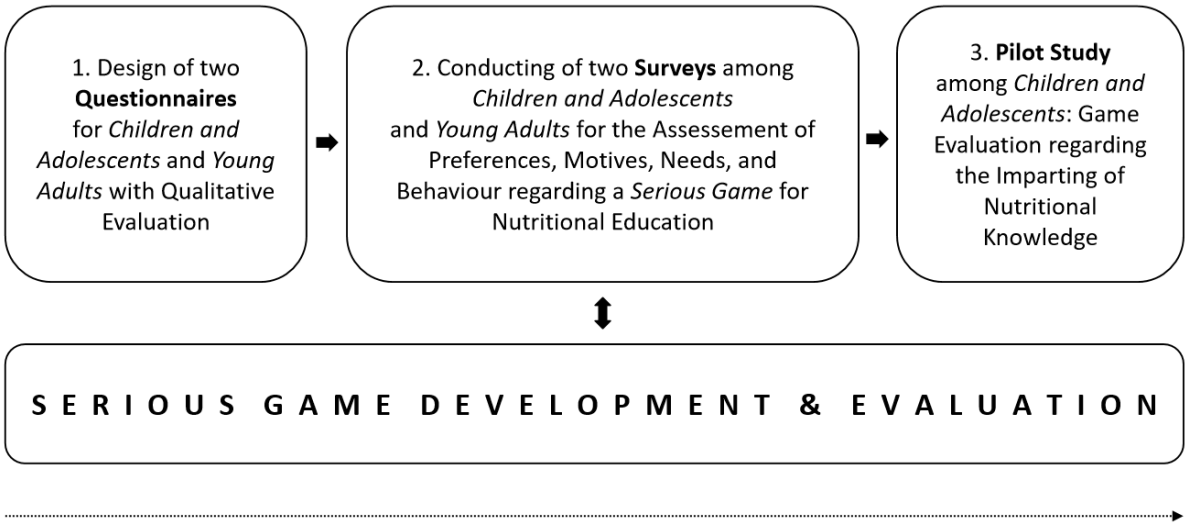

Figure 3. Overview of the Research Steps.

The **first** research step (**Figure 3**) was focused on the design of two questionnaires for the target groups of *children and adolescents* and *young adults*. The questionnaires were developed by an interdisciplinary research team and covered questions on preferences, motives, needs, and behaviour. The standardised questionnaires were used in two surveys among *children and adolescents* and *young adults* (**second** research step, **Figure 3**). The survey of *children and adolescents* was performed in secondary schools in the city and district of Rosenheim, Bavaria. The survey of *young adults*, primarily university students, was conducted online. According to the survey results, a digital game prototype (*Fit, Food, Fun;* FFF) was developed and designed. Finally, a pilot study was conducted to evaluate the short-term effectiveness of the FFF game prototype on the change of nutritional knowledge among *children and adolescents* (**third** research step, **Figure 3**). Finally, the global aim of this thesis was to investigate the effects of a *serious game* for nutritional education, which can be used and distributed by healthcare stakeholders (e.g. health educators) to contribute to the prevention of overweight and obesity in the younger population.

3. Methods

In the following, the methods used for this thesis are described. **First**, two questionnaires were developed and designed to be applied in surveys among the target groups of *children and adolescents* (secondary school students) and *young adults* (university students). **Second**, a *serious game* prototype (FFF) was developed and designed by using the survey findings. **Third**, a pilot study was conducted among secondary school students to evaluate the FFF game prototype regarding its effectiveness to impart nutritional knowledge.

3.1 Questionnaires – Development and Design

The questionnaires were aimed to be applied in surveys to collect data on preferences, motives, needs, and behaviours of *children and adolescents* and *young adults* regarding a *serious game* for nutritional education. The questionnaires were developed by an interdisciplinary team of scientists (nutritional science, computer science, economics, sociology) between 2015 and 2016.

3.1.1 Preliminary Questionnaires

According to the recommendations for a sound questionnaire development and design, the preliminary version of the questionnaire was evaluated qualitatively by the application of a ***pre-test*** [88]. A *pre-test* can be described as an evaluation of the questionnaire before its application in the main survey [88]. The performance of a *pre-test* enables to assess the questionnaire's strengths and limitations (e.g. comprehensibility of wording, layout, syntax) among the target group and to determine whether the questionnaire is appropriate for the main survey [88]. There are different recommendations regarding the population size of *pre-tests*. The literature indicates that a small number of participants is sufficient to identify the main deficiencies and ambiguities of a questionnaire [89,90]. There are different types of *pre-tests*, e.g. *conventional pretesting*, *behaviour coding*, and *cognitive interviewing* (e.g. *probing*) [88]. However, no common recommendation for one single type exists and the combination of different types, e.g. *conventional pre-testing* with *cognitive interviewing* is recommended frequently [89,90]. Therefore, a preliminary version of the questionnaire was evaluated using a *conventional pre-testing* and *probing* as a *cognitive interviewing* method. The *pre-test* was conducted in the city and district of Munich among a subset of 26 *children and adolescents* between 25th January and 2nd February 2016. Participants younger than 18 yrs had to give written parental consent. At the beginning, participants were asked to fill out the questionnaire. Afterwards, a structured interview was performed with each participant. The interview was executed by one research assistant and took approximately 30 min. Different types of follow-up questions (*probes*)

were used (e.g. *general probes*, *comprehension probes*, *category-selection probes*) to collect feedback data about the questionnaire itself (e.g. layout, size), comprehension and difficulties (e.g. questions, response categories), and improvements (e.g. suggestions, wishes, ideas).

After the *pre-test* application, the collected data were analysed. Interview data were clustered and evaluated by two categories: *comprehension* and *concept/design*. According to that, major and minor questionnaire revisions were made. For instance, participants suggested to specify the term *one portion* within the following question: *How many portions of fruits and vegetables should be eaten each day?* Therefore, the term *one portion* was defined as *one handful*. The term *eating and drinking* was replaced by *nutrition*. Since participants disregarded the difference between single- and multiple-choice answer options, a respective remark was added to the introduction. Moreover, additional questions were implemented, while others were replaced or modified. A feedback box was integrated at the end of the questionnaire. Compared to the preliminary questionnaire for *children and adolescents*, the revised version included eight questions more (**see 3.1.2**).

As previously mentioned, it was also aimed to develop and to design a questionnaire for the target group of ***young adults***. Therefore, minor modifications of the questionnaire for *children and adolescents* were made to ensure that the questionnaire is age-appropriate for *young adults*. For instance, specific answer items were added (e.g. *flat sharing community* or *partner*). Moreover, some items were replaced (e.g. *school* by *cafeteria/canteen*). Therefore, a comparison between the datasets of both target groups was facilitated. Several internal pre-evaluations were performed by *young adults* during the development and design processes.

3.1.2 Final Questionnaires

The **final questionnaires** were implemented using EvaSys, an in-house software for the design, distribution, and evaluation of surveys (V7.0, 2101). The first page of the questionnaires (**Appendix, A1 - A2**) contained information about the research project, data protection, and voluntary participation. Finally, advices for filling out the questionnaire were given as well. Different types of questions (closed, open, semi-open) and different types of answer options (single choice, multiple-choice) were implemented. However, closed questions with multiple choice answer options represented the main part of the questionnaire. In total, the final version of the questionnaire for ***children and adolescents*** covered 44 questions (nutrition: 16 questions, digital gameplay: 21 questions, personal characteristics: 6 questions, feedback box: 1 question). The final version of the questionnaire for ***young adults*** included 47 questions (nutrition: 16 questions, digital gameplay: 22 questions, personal characteristics: 8 questions, feedback box: 1 question). The main number of questions addressed preferences, motives, needs, and behaviours of *children and adolescents* to

design a game, which is appealing to the target group. The questions about nutrition referred to nutritional information sources, behaviour, and knowledge. The (digital) gameplay questions were related to the behaviour, the design, and the content of a nutritional game. All data were assessed by self-report. The specification of weight and height ranges was tolerated, if participants were not aware of their current anthropometrics.

3.2 Surveys – Design, Recruitment, and Performance

3.2.1 Survey among Children and Adolescents

The Ethical Committee of the School of Medicine, Technical University of Munich issued a positive vote for the school survey among ***children and adolescents*** (164/16 S). Moreover, the Rosenheim school board approved the survey to be carried out in secondary schools within the city and district of Rosenheim (Bavaria, Germany). In total, 23 secondary school principals were invited by the school board. Finally, six **secondary schools** participated. Two school survey waves were conducted between 2016 and 2017. Teachers invited all students of the 7th, 8th, 9th, and 10th grade to take part in the survey. All students received a printed invitation letter together with a participation information and a consent form. Parents or legal guardians had to give written consent for their child to participate in the survey. Each consent form was reviewed by the study team before the survey start. The **paper survey** was conducted under standardised conditions. At least one study assistant was present. The teachers were free to stay in the room or to leave during the survey. Each participant received a printed version of the questionnaire. At the beginning, the study assistant read the introduction of the questionnaire aloud. Students were engaged to ask questions in case of incomprehensibilities. Finally, students were given a maximum of 45 min (= one school lesson) to fill out the paper questionnaire independently. *Children and adolescents* with no parental permission did not participate and received nutritional quizzes instead.

3.2.2 Survey among Young Adults

The Ethical Committee of the School of Medicine, Technical University of Munich approved the **online survey** (164/16 S). The main recruitment of ***young adults*** (18 to 24 yrs) was performed via university-associated newsletters of both **universities** in Munich (Ludwig-Maximilians-University, LMU; Technical University of Munich, TUM). For instance, the *TUMstudinews* – a newsletter for TUM students – interviewed a member of the *serious game* research group. During this, students were invited to participate in the survey. Besides that, social media (e.g. Facebook) and other digital channels (e.g. digital bulletin board) were used. Moreover, printed flyers were distributed at university cafeterias. All

recruitment strategies were approved by the associated authority. A *Quick Response* (QR) code and a hyperlink (password protected) were used to guide participants to the survey website. All participants gave written consent digitally. The online survey was performed during 2016 and 2017. It was not possible to calculate a response rate, since the exact number of survey invitation recipients was not available. For instance, the newsletter of the *TUM School of Life Sciences Weihenstephan* (first date sent: 2016-12-21, second date sent: 2017-01-12) comprises approximately 5,000 people. Moreover, the *LMU Infodienst* is sent to students of all 20 faculties, who subscribed to the newsletter. Therefore, it is assumed that 5,553 subscribers received the survey invitation (2017-05-17). Finally, it might be estimated that more than 10,000 recipients received the invitation. However, it cannot be ruled out that persons received the survey invitation more than once. **Figure 4** shows the survey participation by month during the survey period (start: 2016-12-21, end: 2017-06-21).

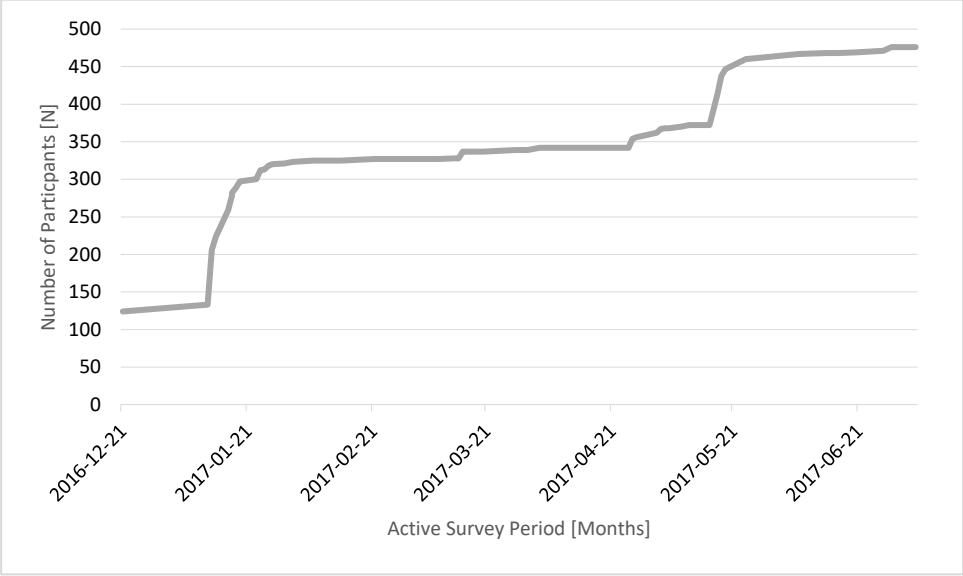

Figure 4. Participation Rate during the Survey Period.

3.3 *Serious Game* – Development and Design

The FFF game is a *serious game* for nutritional education. The game was developed by an interdisciplinary research group at the Technical University of Munich between 2015 and 2018. To develop a target group specific game, a **survey** about *children's and adolescents'* preferences, motives, and needs regarding nutritional education and digital gameplay was carried out. The results of the survey were used for the game design and development process. Moreover, an early game prototype was evaluated qualitatively within three **focus groups** among secondary school students (7^{th}, 8^{th}, 9^{th} grade; 14 to 17 yrs) in summer 2018. Based on the focus groups' feedback, the prototype was revised.

A preliminary version of the FFF game prototype (**FFF game**) was released. The content of nutritional education within the FFF game is based on the recommendations of the German Nutrition Society e. V. (DGE). A short description of the FFF game is presented in the following. The FFF game is designed as a journey across Europe (Map of Europe) and includes three different mini-games (mini-game 1: Energy and Macronutrient Quiz, mini-game 2: Fat, Sugar, and Salt Quiz, mini-game 3: Sports, Physical Activity, Energy Expenditure) **(Figure 5a - d)**.

Map of Europe: Each of the 15 countries offers ten country specific foods and beverages. Food groups and nutritional values of food and beverage items were extracted from *The German Nutrient Data Base* (BLS) [91]. One item per group was randomly selected. **Table 3** gives an overview about the food items of two countries (Germany, Austria).

Table 3. German and Austrian Food Items and Food Groups.

Number	Food Group	German Food Items	Austrian Food Items
1	Meals	Currywurst with French fries	Wiener Schnitzel
2	Sweets	Plum puree	Bonbons
3	Grain products, potatoes	Pumpernickel	Linzer cake
4	Vegetables	Grilled pumpkin	Chickpeas
5	Fruits	Strawberry	Apricots
6	Dairy products	Obatzda	Ricotta
7	Meat, sausage, fish, eggs	Weißwurst	Fried chicken
8	Oils & Fats	Cream spread	Coconut oil
9	Beverage	Fruit tea	Lemon juice spritzer
10	Beverage	Water	Water

The students had to click on one of the green coloured countries depicted on the European map to start the gameplay. After the player has completed (won) all three mini-games within one country, the country turns into red and the next country is released (green) (**Figure 5a**).

Figure 5a - d. Start Screen. Map of Europe (5a), Mini-game 1. Energy and Macronutrient Quiz (5b), Mini-game 2. Fat, Sugar, and Salt Quiz (5c), Mini-game 3. Sports, Physical Activity, and Energy Expenditure (5d).

Energy and Macronutrient Quiz: The player can see randomly displayed images of two different, country-specific foods depicted as food cards. The task is to select the food with the highest content of calories, fat, carbohydrates, or protein (**Figure 5b**) by clicking on the respective food card. Afterwards, the card appears in green (right) or in red (wrong).

Fat, Sugar, and Salt Quiz: The player is instructed to estimate the fat, sugar, and salt content of randomly selected, country specific foods in terms of fat, sugar, and salt content per 100 grams. The estimation of the nutrient content is performed by a slider, which can be moved up and down within pre-defined intervals (**Figure 5c**).

Sports, Physical Activity, and Energy Expenditure: Within this physical activity unit, a random sports activity (running, swimming, cycling) is assigned to the player. The player has the task to fill a backpack with foods and water in order to provide enough energy and liquid to cover a specific distance by doing

the respective sports activity for 30, 45, or 60 min (**Figure 5d**). Moreover, the player is prompted to collect at least five apples (5-a-day recommendation) during his physical activity. After crossing the finish line, the player receives feedback on how many apples were collected and on how many fruits and vegetables are recommended to be consumed each day. Data about the energy expenditure during the different sports activities was based on *Metabolic Equivalents* (METs), released by the *Compendium of Physical Activities* [92]. METs are commonly used measures for the intensity of physical activities and describe the ratio of the *working metabolic rate* relative to the *resting metabolic rate* [93].

Table 4 presents the three different METs, which were used for the calculation of the in-game energy expenditure. Based on the student's weight, the energy expenditure was calculated according to the following equation:

Energy Expenditure [kilocalories] = Duration [hours] * Metabolic Equivalent * Weight [kilogram]

Table 4. Metabolic Equivalents for Types of Physical Activities [92].

Code	METs	Type of Physical Activity
01015	7.5	Bicycling, general
12020	7.0	Jogging, general
18260	10.3	Swimming, breaststroke, general, training or competition

METs = Metabolic Equivalents.

3.4 *Serious Game* – Pilot Study

3.4.1 Recruitment and Participants

This pilot study was approved by the Ethical Committee of the School of Medicine, Technical University of Munich (175/18 S). Moreover, the Rosenheim school board consented to conduct the study within associated schools. Two school principals of secondary schools within the city and district of Rosenheim (Bavaria, Southern Germany) were recruited via Email and telephone calls. In total, both principals consented to participate. One secondary school (*Secondary school Rosenheim at Luitpoldpark*) was in the city of Rosenheim, while the other school (*Primary and Secondary School St. Georg*) was in Bad Aibling, a small town in the district of Rosenheim. School principals forwarded the study invitation to all teachers of the 7th (2) and 8th classes (1). Afterwards, teachers distributed the

invitation for voluntary participation to the students. All students were instructed to show the printed study invitation and participation information to their parents or legal guardians. Each seventh- and eighth-grader with sufficient German language skills and written parental permission was eligible to participate. Each school was assigned either to the gameplay (GG) or the teaching (TG) intervention group. **Table 5** provides an overview about the number of invited and enrolled participants by class and intervention group/school.

Table 5. Number of Participants and Participation Rate per Intervention Group.

Gameplay Group				**Teaching Group**			
Class Name	Class Size [N]	Participants [N]	Participation Rate [%]	Class Name	Class Size [N]	Participants [N]	Participation Rate [%]
7a	19	16	84	7a	19	17	89
7c	19	17	89	7b	16	14	88
8c	15	14	93	8a	22	17	77
Total	**53**	**47**	**89**	**Total**	**57**	**48**	**84**

N = Number.

3.4.2 Study Design and Intervention

The study was conducted within one school week (Monday to Friday) and included two intervention groups (GG = FFF game; TG = classroom teaching). **Figure 6** provides an overview about the design of the pilot study.

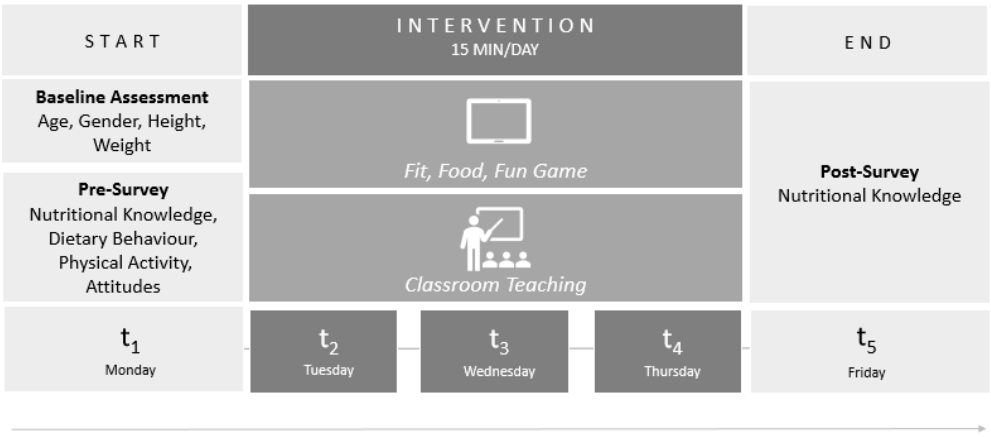

Figure 6. Design of the Pilot Study.

Pre-Assessment: At the **beginning of the study** (Monday), the study team welcomed the participants, gave a brief overview of the week, and verified all consent forms for parental signatures. Afterwards, the **baseline data** (age, gender, height, weight) were assessed and documented by two research assistants. The body height was measured by a mobile stadiometer (seca 214; seca GmbH & Co. KG, Hamburg, Germany). The body weight was assessed by a digital flat scale (seca 803; seca GmbH & Co. KG, Hamburg, Germany). Both measurements were performed in a standardised fashion with clothes and without shoes. As recommended for the younger population [94], the weight classification was based on BMI percentiles. The BMI (kg/m^2) for *children and adolescents* was calculated by using *my BMI 4 Kids*, an online BMI calculation tool (*https://aga.adipositas-gesellschaft.de/mybmi4kids/)* released and recommended by the AGA [8,95]. The primary outcome of the pilot study was the change in nutritional knowledge from pre- to post-intervention. Therefore, a **pre-questionnaire** was applied to assess the **nutritional knowledge** of *children and adolescents* at baseline (**see 3.4.3**).

Intervention: After the pre-assessment, the intervention was applied at the **second, third, and fourth** study day (Tuesday, Wednesday, Thursday) and consisted of either **digital gameplay (GG)** or **classroom teaching (TG)** for 15 min each day. The educational content was similar in both groups and mainly based on recommendations of the DGE for a healthy lifestyle (*10 guidelines of the German Nutrition Society for a wholesome diet*, **Figure 7**).

Figure 7. *10 Guidelines of the German Nutrition Society for a Wholesome Diet* (DGE).

In total, six out of ten rules (= guidelines) were selected (depicted in bold, **Figure 7**), which refer to the recommendations about the following topics: vegetables and fruits (second rule), whole-grain foods (third rule), health-promoting fats (fifth rule), sugar and salt (sixth rule), water and beverages (seventh rule), and weight and physical activity (tenth rule). A short description of both interventions is given in the following paragraph.

Digital Gameplay – FFF game: Students received the gameplay intervention during regular school lessons. The classes were split into groups with a maximum of ten participants. Two research assistants were at least around. The teachers were not present. In total, six intervention groups have emerged.

The study team provided tablets (Samsung Tab S2 T813, Android 7.0; Samsung, Seoul, South Korea) and placed them ready to play at the school bench. After a brief address of welcome, students were instructed to play the **FFF game** for 15 min on each of the three intervention days (Tuesday, Wednesday, Thursday). There was no interaction within the intervention, except students needed technical support (e.g. system crash). In the GG, at least two nutritional rules were presented each day on the tablet screen during gameplay. No study team interaction was desired within the 15-min gameplay intervention. Thus, students were not constrained in their gaming behaviour (e.g. speed). Therefore, it was not possible to ensure that all students proceeded in the same way (e.g. the number of countries discovered). The educational content of the game was prepared according to the two pedagogical models: the *ARCS Model Approach* [96] and the *AVIVA Model* [97]. Further information regarding the FFF game is given elsewhere [98].

Teaching – Classroom and Blackboard: The teaching intervention was executed on Tuesday, Wednesday, and Thursday for approximately 15 min in a structured way according to a standard protocol. The study assistant was instructed to follow the protocol. The nutritional contents were adapted to the game contents. At the beginning of the intervention, the study assistant recited the explanation of two to three nutritional topics (energy, fat, carbohydrates, sugar, protein, vitamins, minerals, dietary fibres, salt). Afterwards, TG participants were educated about the DGE rules using the **blackboard**. After the study assistant has finished the writing on the blackboard, students were given a few minutes to carefully read the texts on the blackboard. After the texts were removed, the students were asked to explain the rule in their own words to the girl or the boy they sit next to. The same procedure was applied for the presentation of the second DGE rule. At the end, students were invited to play a quiz. The study assistant recited a question and asked the students to answer them by speaking their answers out aloud and spontaneously. The correct answer was presented after each question. The type (e.g. estimation of nutritional values) and the content (e.g. food items) of the quiz questions were analogue to the mini-game quizzes, although the scope was shortened.

Post-Assessment: At the **end of the study** (Friday), students filled out the **post-questionnaire**, which includes the same nutritional knowledge questions as the pre-questionnaire, to assess the **nutritional knowledge** after the intervention (**see 3.4.3**).

3.4.3 Outcome Measurements

After the baseline measurement on Monday, students were instructed to fill out a pre-questionnaire about **lifestyle behaviours** (diet, physical activity), **healthy diet attitudes**, and **nutritional knowledge**.

The educational content of the nutritional knowledge questions referred to general recommendations about a balanced lifestyle, with special regard to the nutritional recommendations of the DGE. The pre-questionnaire of both intervention groups covered 36 questions distributed over 17 pages. In total, **19** questions (**6** cloze sentences, **12** closed questions, **1** open questions) were applied to assess the change of nutritional knowledge from pre- to post-intervention. According to the question type, a different number of points could be scored. Each of the six cloze sentence represents one DGE rule and includes four blank text gaps, where students were instructed to fill in their responses. Therefore, a maximum of four points per rule was achieved (6 x 4 = 24). A maximum of one point was given for each of the remaining questions (13 x 1 = 13). In total, a maximum sum of 37 points was achievable. To assess the total knowledge across the 19 questions and to evaluate the change in total knowledge from pre- to post-intervention, an *overall knowledge* category was defined. The change in nutritional knowledge (%) was assessed by calculating the proportion of achieved number of points relative to the maximum of achievable points.

Furthermore, the **dietary behaviour** was assessed by a food frequency questionnaire (FFQ), which is part of the *Leipzig Lifestyle Questionnaire for Adolescents*, 2007 [99]. The 45-item FFQ includes eight food and five beverage categories with corresponding items (31 food items, 14 beverages items) with respective frequency values (never = 1, rare = 2, several times a month = 3, several times a week = 4, daily = 5). For the assessment of the consumption frequency, the frequency values of each food and beverage item within one category were summarised. Finally, there were total values for eight food and five beverage categories, which were interpreted by a standard evaluation sheet (adverse, acceptable, optimal). To calculate an *overall dietary score*, each of the 13 categories was multiplied by a value of 1 (for adverse), 2 (for acceptable), or 3 (for optimal). Afterwards, the results were summed up and divided by the number of categories (13). Finally, each result (1 to 3) was again assessed by the three dietary behaviour dimensions (adverse, acceptable, optimal) indicating an *overall dietary score* for each participant.

Data on the leisure-time physical activity during summer and winter was collected by the questionnaire and evaluated by a **physical activity score** (no, moderate, high) according to *Strobl et al.* [100]. Moreover, the attitude and the importance of healthy eating were also assessed. However, game-based questions were asked, which are not further addressed in this thesis.

3.5 Statistical Analyses

3.5.1 Surveys among Children and Adolescents and Young Adults

The raw data of the survey among ***children and adolescents*** were checked for integrity and plausibility using Microsoft Excel 2013 (Microsoft Corp). *Children and adolescents* with ≥ eight unanswered or invalid questions were excluded from the analysis. Frequencies (absolute and relative) and further descriptive statistics (e.g. means) were calculated using SPSS version 24 (IBM Corp). The number of responses varied between questions, since there were multiple answer choices. The underlying statistical analysis is based on a selection of 21 out of 44 questions.

The raw data of the survey among ***young adults*** were checked for integrity and plausibility. In accordance with the procedure for *children and adolescents*, participants, who had ≥ eight unanswered or invalid questions, were excluded. All analyses (e.g. frequencies, means) were performed using Microsoft Excel 2013 (Microsoft Corp). The statistical analyses are based on a selection of 18 out of 47 questions.

3.5.2 Pilot Study among Children and Adolescents

For the description of the study population's baseline characteristics, healthy diet attitudes, and physical activity behaviour, two-sample t-tests were applied for metric variables (e.g. age) and chi-squared tests of independence were performed for categorical variables (e.g. behaviour scores) to analyse differences between both intervention groups. To assess the changes regarding the primary outcome *nutritional knowledge* and to test for intervention effects within the intervention groups from baseline (pre) to post-intervention, paired t-tests were used. To test for intervention effects between both intervention groups (differences in nutritional knowledge from pre- to post-intervention), two-sample t-tests were performed. Moreover, linear regression models were fit and adjusted for the following variables: *gende*r, *overall knowledge at baseline*, and *number of intervention days*. Finally, p-values of < 0.05 were considered as statistically significant. The underlying analyses were performed using the statistical software R 2018 (R Core Team, Vienna, Austria).

4. Results

In the following, a summary of the main findings from the three underlying publications is given.

4.1 Publication 1: Digital Gaming for Nutritional Education: A Survey on Preferences, Motives, and Needs of *Children and Adolescents*

Summary: *Serious games* are digital tools for nutritional education among *children and adolescents.* The aim of this work was to perform a survey among *children and adolescents* to assess *children's and adolescents*' preferences, motives, and needs regarding *serious games* for nutritional education. In total, 293 (137/293, 46.8 % girls) secondary school students (Rosenheim, Bavaria) participated with a mean age of 14.7 ± 1.2 yrs, a mean weight of 60.2 ± 13.2 kg, and a mean height of 1.7 ± 0.1 m. The results revealed that most of *children and adolescents* acquire digital nutritional information by the internet (166/291, 57.0 %) and television (97/291, 33.3 %). School education (161/291, 55.3 %) and parents or other adults (209/291, 71.8 %) are the mainly used non-digital information sources. The most desired additional (non-digital) information source are schools (108/274, 39.4 %). Almost the same proportion of participants use (23/291, 7.9 %) and want to additionally use (19/274, 6.9 %) digital games for (digital) nutritional information. Moreover, a minor proportion of the survey population (16/290, 5.5 %) answered the four questions regarding nutritional knowledge correctly. The main proportion of participants (242/283, 85.5 %) play digital games. Moreover, 61.0 % (144/236) play digital games daily (smartphones or tablets). Two-third of participants (151/227, 66.5 %) play digital games continuously for ≤ 30 min using smartphones or tablets. Most participants play digital games for pleasure (209/282, 74.1 %), boredom (164/282, 58.2 %), or alone at home (117/282, 41.5 %). Half of participants (144/280, 51.4 %) are interested in receiving information about nutrition during digital gameplay and prefer being educated about nutrition by in-game quizzes (157/287, 54.7 %) and tasks (123/287, 42.9 %). These findings suggest that nutritional knowledge is deficient among *children and adolescents*. Moreover, *children and adolescents* play digital games and are also interested in nutritional education during gameplay. Therefore, a *serious game* might be an adequate tool for nutritional education among *children and adolescents*.

Contribution: The doctoral candidate co-designed and conducted the survey, performed the data management and analyses, drafted, revised, and approved the final manuscript.

Holzmann, S.L.; Dischl, F.; Schäfer, H.; Groh, G.; Hauner, H.; Holzapfel, C. Digital Gaming for Nutritional Education: A Survey on Preferences, Motives, and Needs of Children and Adolescents. *JMIR Form. Res.* **2019**, 3, e10284, doi:10.2196/10284. [101]

4.2 Publication 2: *Serious Games* for Nutritional Education: Online Survey on Preferences, Motives, and Behaviors Among *Young Adults* at University.

Summary: In Germany, little is known about *young adults*' preferences, motives, and needs about digital gameplay, especially in the context of a *serious game* for nutritional education. Moreover, data about the digital and non-digital nutritional information strategies of *young adults* is limited. Aim of the online survey was to describe the target group of *young adults* regarding the previously mentioned aspects. In total, 468 *young adults*, primarily university students (81.0 %, 379/468), participated in the online survey between 2016 and 2017. The majority of participants were female (342/468, 73.1 %) and aged between 18 to 24 years (269/468, 57.5 %). Most participants reported to live at home (193/468, 41.2 %) or in a flat sharing community (166/468, 35.5 %). The survey population had a mean weight of 65.5 ± 14.0 kg. According to the BMI (mean: 22.3 ± 3.6 kg/m^2), the weight of most participants (346/447, 77.4 %) was classified as normal. Moreover, the main proportion of participants reported to use the internet (372/467, 79.7 %) to acquire nutritional information. Besides that, printed media (books and newspapers) are the most used non-digital information sources (298/467, 63.8 %). One out of ten participants (46/461, 10.0 %) stated to want digital games as an additional (digital) information source and close to one-third (146/461, 32.1 %) reported to prefer the university and job environment as an additional (non-digital) source for nutritional education. Furthermore, the survey revealed that most participants (293/468, 62.6 %) play digital games. More than one-fifth of participants (97/456, 21.3 %) play digital games on smartphones or tablets daily. The main motives for digital gameplay were pleasure (199/442, 45.0 %) and boredom (190/442, 43.0 %) and the most frequent setting for digital gameplay was on the go (101/442, 22.9 %) and alone at home (153/442, 34.6 %). The main proportion of participants (343/468, 73.3 %) is interested in receiving nutritional information during digital gameplay. Close to one-third of the survey population reported to prefer being educated by quizzes and by solving tasks during digital gameplay (323/463, 69.8 % vs. 333/463, 71.9 %). This survey provides findings on *young adults*' nutritional information strategies and digital gameplay behaviours, preferences, and motives. Since *young adults* play digital games and are also interested in nutritional education during digital gameplay, a *serious game* about nutrition might be an appropriate educational tool for *young adults*.

Contribution: The doctoral candidate co-designed and conducted the survey, performed the data management and analyses, and drafted, revised, and approved the final manuscript.

Holzmann, S.L.; Schäfer, H.; Groh, G.; Plecher, D.A.; Stecher, L.; Klinker, G.J.; Hauner, H.; Holzapfel, C. Serious Games for Nutritional Education: Online Survey on Preferences, Motives, and Behaviors Among Young Adults at University. Accepted in *JMIR Serious Games* (2020-04-23).

4.3 Publication 3: Short-term Effects of the *Serious Game* "Fit, Food, Fun" on Nutritional Knowledge: A Pilot Study among *Children and Adolescents*

Summary*: Serious games* are digital tools, which can be used for nutritional education among *children and adolescents.* As the development of overweight and obesity among *children and adolescents* often increases with school entry, the school environment is an appropriate setting for educational interventions. The aim of this pilot study was to examine whether an educational intervention delivered by either digital gameplay or classroom teaching can increase nutritional knowledge among secondary school students. This pilot study was conducted from June to September 2018 in two secondary schools in the city and district of Rosenheim during one school week. Two educational interventions (digital, non-digital) had analogue contents and were applied for 15 min at each of three consecutive intervention days. The gameplay intervention group (GG) played the *Fit, Food, Fun* game autonomously, while the teaching intervention group (TG) received classroom teaching by a study assistant. The primary outcome *nutritional knowledge* was assessed by a questionnaire at baseline and post-intervention. In total, 39 GG participants (13/39, 33.3 % girls) with a mean age of 13.5 ± 0.7 yrs and 44 TG participants (12/44, 27.3 % girls) with a mean age of 12.8 ± 0.9 yrs started the intervention. Approximately one-half of both intervention groups had on average a normal weight (GG: 19/39, 49 % vs. TG: 27/44, 61 %). The dietary behaviour (mean dietary score) was acceptable among most participants (GG: 1.9 ± 0.2 vs. TG: 2.0 ± 0.2). Close to 60 % of GG (22/38, 58 %) and TG (27/42, 64 %) participants showed moderate levels of physical activity. The pilot study revealed that both interventions significantly increased nutritional knowledge (GG: $p = 0.001$ vs. TG: $p < 0.0001$). Compared to the GG, there was a significantly higher improvement of nutritional knowledge in the TG ($p = 0.01$). This pilot study demonstrated that short-term educational interventions (digital and non-digital) can increase nutritional knowledge among *children and adolescents*. Further research is warranted to evaluate the long-term effectiveness of the *serious game* on the imparting of nutritional knowledge. Moreover, it needs to be investigated whether improvements of nutritional knowledge have an impact on dietary behaviour changes.

Contribution: The doctoral candidate co-designed and conducted the study, performed the data management and analyses, drafted, revised, and approved the final manuscript.

Holzmann, S.L.; Schäfer, H.; Groh, G.; Plecher, D.A.; Klinker, G.; Schauberger, G., Hauner, H.; Holzapfel, C. Short-term Effects of the Serious Game "Fit, Food, Fun" on Nutritional Knowledge: A Pilot Study among Children and Adolescents. *Nutrients* **2019**, *11*, 2031, doi:10.3390/nu11092031. [102]

5. Discussion

The **first aim** of this thesis was to describe the motives, preferences, and needs of *children and adolescents* and *young adults* regarding a *serious game* for nutritional education using surveys. The surveys revealed that most of the participants play digital games, with *children and adolescents* reporting that more frequently than *young adults.* Most of the *children and adolescents* and *young adults* were also interested in nutritional education during digital gameplay. The **second aim** was to design a *serious game* for nutritional education. Therefore, the results of the survey among *children and adolescents* were implemented in the *serious game* prototype named FFF. The **third aim** was to investigate the short-term effectiveness of the FFF game on nutritional knowledge within a one-week pilot study among *children and adolescents*. The gameplay intervention group, who played the FFF game, was compared to an intervention group, who received a classroom teaching intervention. After the three intervention days, both groups significantly increased nutritional knowledge from pre- to post-intervention.

5.1 Nutritional Education by *Serious Games*

There is a growing evidence for the efficacy of *serious games* on health-related outcomes (e.g. diet) and its determinants (e.g. nutritional knowledge) [73,103,104]. As previously described, a significant change in nutritional knowledge was detected for the use of the FFF game among *children and adolescents* [102]. Moreover, it was shown that also classroom teaching significantly increased nutritional knowledge [102]. *Casazza and Ciccazzo* (2007) conducted a study on different delivery methods for health education among students (13 to 18 yrs, μ_{age}: 15.8 yrs) and showed that both the computer-based intervention group (CD-ROM) and the traditional education group (lectures, pamphlets) increased nutritional knowledge significantly from pre- to post-intervention (computer-based intervention group: 40.4 + 1.25 to 53.2 + 1.19, $p < 0.001$ vs. traditional education group: 42.8 + 1.19 to 50.9 + 1.12, $p = 0.003$) [105]. However, no significant changes occurred in the control group and no significant between-group differences were detected [105]. This is in contrast to the results of the FFF game, where the traditional group was significantly more effective [102]. Another study showed that adolescents (N = 47, mean age: 14.9 ± 1.0 yrs), who played the web game *Gustavo in Gnam's Planet* at least half an hour per day for one week, significantly ($p < 0.05$) increased nutritional knowledge from pre- (70.0 ± 9.2) to post-intervention (71.3 ± 10.0) [106], which is in line with results of this pilot study. It should be mentioned that improvements were rather small, which calls into question, whether this change in nutritional knowledge has a practical impact, e.g. on dietary behaviour.

The overarching aim of educational interventions on nutrition is to influence the dietary behaviour by increasing the consumption of healthy foods and/or decreasing the consumption of unhealthy foods. *Long et al.* (2004) investigated the effects of a combination of a digital (web, 5 hr) and a non-digital (classroom, 10 hr) educational intervention on self-efficacy for healthy eating by a quasi-experimental study among 121 high-school *children and adolescents* during one month [107]. Compared to controls, who received nutritional education during the regular school curriculum, the intervention group showed a significantly higher self-efficacy for healthy dietary choices and dietary knowledge, whereas no between-group differences were detected for dietary intake [107]. Self-efficacy is a core construct of the *Social cognitive theory* (SCT), a behaviour change technique, developed by the Canadian psychologist *Albert Bandura* and is considered to be necessary to predict and to elicit behaviour change [108]. Results of the study by *Long et al.* (2004) showed that increasing the self-efficacy is not sufficient to induce dietary behaviour changes among the younger population [107]. Moreover, some studies went further and investigated the effects of diet-related behaviour change on weight outcomes. According to a systematic review on the application of digital games (*serious games, exergames*, and combined approaches targeting nutrition, physical activity, and obesity) for the prevention and treatment of obesity among *children and adolescents* (7 to 15 yrs), the majority of studies reported positive effects on weight, physical activity, dietary behaviour, and nutritional knowledge [104]. For instance, the subgroup analyses indicated small to large effect sizes for *serious games* on nutritional knowledge/behaviour, with no effect on the BMI [104]. Since the standalone application of digital games might be not sufficient, authors suggest to use digital games as an *additional guided component* within obesity prevention and treatment programs [104]. Although the FFF pilot study was effective regarding the imparting of nutritional knowledge, it remains unknown whether this effect was clinically relevant for a change in dietary behaviour. The literature indicates that increases in nutritional knowledge can affect dietary behaviour change [109–112]. However, nutritional knowledge is a *necessary but not sufficient factor* for dietary behaviour change [112]. Therefore, the explanatory role of nutritional knowledge is not finally clarified and the scientific evidence remains controversy and limited [112]. *Jasti et al*. (2017) identified the weight status as a mediator between the knowledge of SSB and the consumption of SSB [113]. It has been shown that students with overweight, who had less knowledge on SSB, also had a higher SSB consumption (OR = 3.56, CI 1.57 - 8.06) [113]. Moreover, a postal survey among more than 1,000 adults indicated that nutritional knowledge was significantly associated with healthy dietary behaviours [111]. In contrast, according to a cross-sectional survey among university students, the knowledge of healthy foods is not associated with the consumption of healthy snacks [109]. A literature review on nutritional knowledge and dietary behaviour change suggest that there is a low evidence base regarding a relationship [112]. Nevertheless, authors

acknowledge that nutritional knowledge *may play a small but pivotal role* for changes in dietary behaviours [112]. Finally, nutritional education programs that follow a holistic approach and focus not only on behaviour but also on knowledge and combine findings from research, theory, and practice are more likely to be effective [114]. Since the dietary behaviour change was not assessed during this pilot study, no conclusions regarding the impact of nutritional knowledge on dietary behaviours changes can be drawn. To address this research question, a long-term study with follow-up periods among a larger and more diverse study population would be necessary.

By now, there is a growing body of evidence for the application of *serious games* in the promotion of health-related outcomes. Because the effects on not only knowledge, but also on weight-related outcomes among *children and adolescents* remain rather small [104,115], literature suggest not to use games as a standalone application within obesity prevention [104]. Instead, combined family and school-based, multi-component behaviour changing programmes, which are supported by community interventions, should be implemented [115,116]. Moreover, also the delivery mode of nutritional information may have an impact on behaviour changes [35,105].

5.2 Current Status of *Serious Games*

The research in the field of *games for health* is growing with the younger population as a primary target group [73,117]. According to a systematic content analysis of more than 1,700 health games, most digital games were developed in the United States (US) 67 %) and in France (19 %), while Germany produced only 3 % [118]. These results suggest that, compared to other nations, the development and design of *serious games* is rather in its infancy in Germany. By now, there is a lack in standards and guidelines for the design of *serious games* for health purposes [119]. The current literature indicates that *serious games for health* need to be individually tailored to be most effective [76,120,121]. A meta-analysis on *serious games* for healthy lifestyle promotion postulates that games should be individually tailored to socio-demographic characteristics (e.g. age) and behavioural change needs (e.g. knowledge status) [55]. Therefore, in preparation of the FFF game design, a survey was conducted to assess *children's and adolescents'* preferences, motives, and needs [101]. The survey indicated that a minor proportion of the survey population was able to correctly answer all questions regarding nutritional knowledge [101]. These findings suggest that nutritional knowledge was rather low in this age group. Therefore, the focus of the game design was to convey nutritional knowledge by implicit and explicit types of learning strategies [98].

Moreover, the literature indicates that tailoring the game design according to the target groups' personality types improves effectiveness regarding attitudes, behaviour change, and self-efficacy [120].

The design of a *serious game* is a cost- and time-intensive process [60], which is recommended to be conducted as a multidisciplinary activity [122]. Since gamification is defined as *the use of game design elements in non-game contexts* [123], the design of *serious games* requires the expertise of different professionals both ensuring *fun-ness* and *serious-ness* [122]. For instance, the *serious games Gustavo in Gnam's Planet* [106], DIAB, and NANO [75] were developed by a multidisciplinary research group. Within this thesis, the design and development of the FFF game was also performed by an interdisciplinary research team. *Baranowski et al*. (2016) recommend to involve all stakeholders in the development process of a *serious game*, including *organizational implementers, policy makers, players and their families, researchers, designers, retailers, and publishers* [119]. In preparation to the game evaluation, formative research might be beneficial to gather data about *viability, acceptability, and comprehension* [122]. Former studies on the design of *serious games* also included formative assessment with the respective target groups [40,122,124,125]. Therefore, the FFF game prototype was qualitatively evaluated during three focus group discussions. Moreover, it is necessary to characterise the target groups regarding their preferences, e.g. type of desired information and type of format [76,126]. Therefore, the FFF game design was based on results of a survey among *children and adolescents* [101]. Design and evaluation standards for *serious games* and respective studies are required to ensure a sound game development/design and to facilitate the comparability of study outcomes. This would enable researchers to draw general recommendations for the application of *serious games* for different age groups and settings. Although there are no common standards available, there are several scientific publications and recommendations for the development and design of *serious games* provided by the *games for health* community [59,76,85,120,122,125,127–130]. Moreover, although several *serious games* are evaluated, the respective research still lacks strict evaluation standards and high-quality studies with adequate sample sizes and reasonable intervention and follow-up periods [103,117,131,132]. According to a review of 27 articles about 25 *games* for health behaviour change, there is a great variability between the studies regarding, e.g. design, measures, and primary outcomes [60]. The target outcomes included *knowledge, psychosocial variables, behaviours, anthropometric, physiologic, and health-outcome variables* [60]. A systematic review on 38 RCTs investigating the effects of video games on health-related outcomes showed that 66 % of the studies included follow-up periods shorter than twelve weeks and only 11 % of the studies were blinded. The authors acknowledge that the study quality was generally low [133]. A scoping review of games for nutritional education and dietary behaviour change investigated the diet-related

information in selected games of 22 publications diversity and concluded that the scientific quality was poor [103].

5.3 Digital Media and Lifestyle Behaviours

Since digital games exist, there is an ongoing debate about possible adverse effects induced by sedentary media. Digital games have a negative connotation, due to their time-spending nature [134]. *Children and adolescents* increasingly spend their leisure time with non-active behaviours (e.g. television, internet, smartphones, computer games). In particular, this applies for the *millennials*, who grew up in an environment, characterised by the use of digital media [135]. The increasing juvenile use of digital media has several side effects [135]. With respect to lifestyle behaviours, the promotion of sedentary activities, unhealthy diets, and weight gain is critically scrutinised [136]. Moreover, the loss in social competencies across childhood is discussed [137]. Besides *exergames*, which are not further addressed within this thesis, digital games are not aimed to increase physical activity by real movements during gameplay (*non-active games*). Consequently, gameplay is associated with increased screen time and sedentary activities. Moreover, it remains unclear whether the results of studies, which show positive associations between general screen time exposition (e.g. television) and weight-related outcomes, are generalizable to video gaming [136]. For instance, a meta-analysis on 14 cross-sectional studies about the relationship of screen time (television) and childhood obesity revealed that an increased television exposition is associated with an increased risk for obesity among children [138]. A further meta-analysis showed a small, but statistically significant association between television screen time and body fatness in *children and adolescents* (3 to 18 yrs) [139]. Moreover, there was a negative relationship between screen time (television) and physical activity [139]. In contrast to that, a recent meta-analysis of 20 studies showed that there is a positive association between video gaming and body mass [136]. This association was significant for adults, but not for *children and adolescents* [136]. The results suggest that the type of screen exposition affects weight differently. Moreover, there is a difference in the vulnerability for screen time-induced weight gain across age groups. However, it has to be mentioned that lifestyle behaviours are affected by a variety of determinants, which suggest that the relationship between sedentary behaviours and health outcomes is influenced by more than one single determinant [139].

Besides the effects induced by a *normal* use of digital media, there are also health consequences, which result from a *non-normal* gaming behaviour. It is acknowledged that individuals use digital games as a coping strategy to escape from psychosocial burdens in the real-world and to retreat into the game world, a phenomenon called *escapism* [134]. This might induce and promote an excessive use of digital games, also known as *excessive*, *addictive*, or *problematic gaming*. This way of gaming is considered as

pathological and is classified as a *behavioural addiction* in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) – 5 [140]. According to the *International Statistical Classification of Diseases and Related Health Problems* (ICD) – 11, a *gaming disorder* was recently classified as *disorders due to addictive behaviours*, a newly released diagnostic group [141]. The literature indicates that players of online role-games are one of the most vulnerable groups for problematic gaming [134,142]. Moreover, problematic gaming is associated with several comorbidities, e.g. *Depression* and *Attention Deficit Hyperactivity Disorder* (ADHD) [134,143]. According to a meta-analysis, there is a small but significant relationship between the use of media and ADHD-related behaviours (e.g. impulsivity) [144]. Since excessive gaming is time-consuming, the time for other requirements, e.g. school and friends, is also reduced [134]. A study among more than 7,000 Slovak *children and adolescents* (11 to 16 yrs) showed that the screen time (internet, computer) during leisure time is associated with school difficulties, a lower sleeping quality, and a higher consumption of SSB [145]. A further study in more than 360 Swiss *children and adolescents* (12 to 17 yrs) investigated the relationship between the use of electronic media at night and sleep disturbances and *Depression* symptoms [146]. It was shown that electronic media use was related to depressive symptoms, which was mediated by increased sleep difficulties and decreased sleep durations [146]. Compared to conventional mobile phones, smartphones were positively associated with electronic media use and later bedtimes [146]. Furthermore, a meta-analysis of more than 100 studies among *children and adolescents* revealed that video games have a minimal impact on *increased aggression (r = .06), reduced prosocial behaviour (r = .04), reduced academic performance (r = −.01), depressive symptoms (r = .04), and attention deficit symptoms (r = .03)* [147]. According to two cross-sectional surveys among 4,810 German and 4,473 US *children and adolescents*, the socio-economic status was inversely associated with BMI, partly mediated by television, but not by video gaming [148]. One possible explanation for this association could be that the younger population is exposed to food advertising during television [149]. A study across 13 commercial television channels in the UK demonstrated that fast food is one of the most advertised food groups [149]. However, advertising is also implemented in digital games. Thus, on the one hand, there are *serious games* for nutritional education, which aim to educate individuals to promote healthier food choices. On the other hand, there are also games available, which have commercial intentions and intend to promote unhealthy food choices (e.g. calorie-dense and nutrient-poor foods). These games are called *advergames* (advertisement + games) and are provided on food companies' websites [150,151]. A study revealed that the exposition to online *advergames* is associated with a higher consumption of snacks and a lower consumption of fruits and vegetables among more than 100 *children and adolescents* (7 to 12) [150]. Since *advergames* on US company websites are frequently visited by US children (1.2 million per month) [150], it could be assumed that *advergames* might have

an unfavourable effect on the young population`s dietary behaviour and weight status in the short- and long-term. This challenge should also be addressed by parents and educational caregivers. However, since gaming disorders have a complex psychosocial background, the underlying concept and process is not fully understood [152]. Moreover, there is often no distinction between the different types of screen time exposition within respective evaluation studies. This might be crucial as television for instance is considered as a passive and video gaming as an active behaviour [151].

Besides that, the assessment of the problematic use of digital games has limited validity, which is caused by, e.g. different measuring instruments and a lack in representativity [134]. Moreover, there is also a need for long-term follow-up studies [152]. These methodological limitations generate different results and therefore lack in comparability. For instance, the proportion of affected individuals varies from 0.2 % to 34 % [134]. A representative survey among more than 3,000 US adults (18 to 60 + yrs) showed that a moderate to extreme severity of problem video gaming was prevalent among only five percent of participants [142]. The prevalence of problematic gaming is estimated at approximately three to five percent among adolescents and *young adults* in the German-speaking area [134,153]. From a public health perspective, the focus should be not only on the promotion of general media competencies, but also on the enhancement of general life competencies with the involvement of parents and teachers [134]. Although most games are for free, games also offer additional options (e.g. in-app), which are chargeable [134]. Therefore, parents should monitor their children's gaming activities carefully, which also requires awareness and media literacy among parents [154]. Since a prohibition of digital games is not recommended, parents and education professionals should communicate a competence-enhancing, but also regulatory way of digital gaming [134].

Taken together, the use of digital games can promote screen time exposition and can lead to pathological gaming behaviours. Several consequences are discussed, whereby the empirical evidence of negative effects on physical activity and weight might be rather low. Although meta-analyses showed some associations, it is debatable whether these effects are of clinical relevance [139]. The aim of this thesis was to design a *serious game* for nutritional education, which could be applied as an educational intervention by teachers in schools. Due to the time restricted and controlled application of the FFF game within the school environment, it could be assumed that the FFF game is not at risk for excessive gaming. Moreover, the findings of both surveys revealed that only a minor proportion of *children and adolescents* and of *young adults* plays digital games for longer durations (more than one hour) [101].

5.4 Strengths and Limitations

There are several strengths and limitations of this thesis, which are addressed in the following. The main strength is that the game development and design was performed according to current recommendations given in the scientific literature. For instance, the FFF game was developed, designed, and evaluated by an **interdisciplinary team** of university researchers. The target group of *children and adolescents* has been involved in all research steps (survey, focus groups, pilot study). It is known that educational programs lack in the consideration of the target groups' perspectives. Therefore, a **survey** among *children and adolescents* was conducted first to collect data about the target groups' motives, preferences, and needs regarding a *serious game* for nutritional education [101]. Afterwards, the survey results of around 300 participants were implemented in the game development and design [98]. Subsequently, a first FFF game prototype was released and evaluated qualitatively within three **focus groups**. Besides the features, content, and design, the systems' usability was discussed as well. Based on these findings, the FFF game prototype was revised to ensure that the game is age appropriate. The effectiveness of the revised FFF game prototype was then evaluated within a **pilot study** (primary outcome: nutritional knowledge) among secondary school students [102]. Schools are a favourable setting to address *children and adolescents* for game-based interventions, since *serious games* might be an appealing alternative to didactic classroom lessons [122]. Thus, the performance of school-based interventions requires the consent and the cooperation of school districts, principals, and teachers. Therefore, it is recommended to create *networks of systems, schools, and teachers* [122]. Due to the **collaborative cooperation** of all parties, each development, design, and evaluation step (survey, focus groups, pilot study) could be carried out within the same school district and at the same schools. The **questionnaires** applied were developed by an interdisciplinary team and covered all information, which were considered as necessary for the game development and design process. However, it might be a limitation that the questionnaires for *children and adolescents* and for *young adults* were not validated. Besides that, there are further limitations. The research of the underlying work was conducted in one **setting and area**. For instance, the survey among *children and adolescents* was carried out at secondary schools in Rosenheim, while the survey among *young adults* was performed at the two Munich universities. Therefore, the survey samples might be not representative, which limits the **generalizability** of the results. This also applies to the pilot study. Although the pilot study revealed positive effects on nutritional knowledge, results are not representative. Furthermore, the study (three days) and intervention (15 min per day) **duration** was short. Moreover, the results might be influenced by the **study design** (no blinding, no randomisation). Since the interventions were applied in schools and not in daily life, it might be assumed that the **educational environment** has influenced the performance of participants.

5.5 Conclusion and Outlook

The surveys among *children and adolescents* and *young adults* revealed that both target groups play digital games and are also interested in nutritional education by digital gameplay. Moreover, it was shown that nutritional education interventions can improve nutritional knowledge among *children and adolescents.* This supports the aim of this thesis to develop a *serious game* for nutritional education. Since the **evidence** for the effectiveness of *serious games* on nutrition-related outcomes (e.g. nutritional knowledge, dietary behaviour) is limited, especially in Germany, further research is warranted. There is a need for high-quality studies (e.g. RCTs) among representative study populations with considerable intervention lengths (e.g. six months) and adequate follow-up periods (e.g. two years) to assess the effectiveness of *serious games* in the long-term. Furthermore, it should be addressed that a positive change in **nutritional knowledge** does not necessarily translate into healthier dietary behaviours. Accordingly, further research should also evaluate the impact of *serious games* on *children's and adolescents'* dietary behaviour and anthropometric parameters (BMI) and their association with nutritional knowledge. Moreover, since **parents** are known as nutritional gatekeepers for *children and adolescents*, this target group should be addressed by nutritional education programs as well. Therefore, it might be indicated, not only to consider parents' perspectives within future game design processes, but also to develop a nutritional education game for parents (and their children). Since nutritional education is part of c*hildren's and adolescents'* school curricula, the involvement of **teachers** in the game design might be beneficial as well. Compared to *children and adolescents*, *young adults* reported more frequently to desire nutritional information during digital gameplay. As the development and the evaluation of a ***serious game* for *young adults*** were not performed within this thesis, further research should focus on that. At present, digitalisation at German schools and German universities is rather low compared to other European countries. Therefore, this limitation should be addressed and stressed by politics in the first place. However, in the long perspective, it might be conceivable that evidence-based *serious games* will be part of the daily curriculum in educational settings. Finally, a **continuous evaluation** by qualitative (e.g. focus groups) and quantitative (intervention studies) research is essential to adapt the *serious game* to the changing needs of its target group.

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Appendix

A1 – Questionnaire for *Children and Adolescents*

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EvaSys	Fragebogen für die Altersgruppe (AG) 14-17 Jahre	Electric Paper
Testumfrage		TUM

Bitte so markieren: ☐ ☒ ☐ ☐ ☐ Bitte verwende einen Kugelschreiber oder nicht zu starken Filzstift. Dieser Fragebogen wird maschinell erfasst.
Korrektur: ☐ ■ ☐ ☒ ☐ Bitte beachte für eine optimale Datenerfassung die links aufgezeigten Hinweise beim Ausfüllen und Korrigieren.

Liebe Schülerin, lieber Schüler,

die Technische Universität München (TUM), genauer gesagt das Institut für Ernährungsmedizin, führt Befragungen von Jugendlichen zum Ernährungs- und digitalen Spielverhalten durch. Mit der Beantwortung des Fragebogens unterstützt Du eine Umfrage, in welcher wir die Ernährungsinformation in Deinem Alter verbessern wollen. Deine Teilnahme an unserer Umfrage ist freiwillig und alle Antworten werden vertraulich behandelt.

In diesem Fragebogen geht es nicht um richtige oder falsche Antworten oder um Noten. Es geht darum, dass Du uns DEINE eigene Meinung und DEINE eigenen Gewohnheiten mitteilst.
Bitte füll' diesen Fragebogen sorgfältig und vollständig aus! Bitte lies' Dir die Fragen gründlich durch und sprich' Dich nicht mit Deinen Nachbarn ab!
Bitte beachte bei jeder Frage den Hinweis, ob Du eine oder alle passenden Antworten ankreuzen darfst!

Wir freuen uns, dass Du bei unserer Umfrage mitmachst.
Vielen Dank!

Dein Umfrage - Team

1. Ernährungsfragen

1.1 **Welche Veränderung(en) wünschst Du Dir rund um das Thema "Ernährung"?**
(Kreuze bitte alle passenden Antworten an!)

Ich wünsche mir ...

☐ zu Hause Obst / Gemüse	☐ in der Schule Obst / Gemüse	☐ zu Hause Süßigkeiten
☐ in der Schule Süßigkeiten	☐ zu Hause Fastfood / Fertigprodukte	☐ in der Schule Fastfood / Fertigprodukte
☐ Kocherlebnisse mit Familie / Freunden/innen	☐ Kochrezepte / Kochkurse	☐ Informationen über Ernährung
☐ Sonstige Veränderung(en): _____	☐ Keine Veränderung(en)	

1.2 **Wo wirst Du über Ernährung informiert / Wo informierst Du Dich über Ernährung?**
(Kreuze bitte alle passenden Antworten an!)

☐ Schulunterricht	☐ Eltern / Erwachsene	☐ Freunde/innen
☐ Bücher / Zeitschriften	☐ Unbewusst (Werbung)	☐ Fernsehen
☐ Internet	☐ Soziale Netzwerke	☐ Apps
☐ Digitale Spiele (Smartphone, PC, Konsole)	☐ Keine Antwort trifft zu	

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EvaSys	Fragebogen für die Altersgruppe (AG) 14-17 Jahre	Electric Paper

1. Ernährungsfragen [Fortsetzung]

1.3 **Wo willst Du zusätzlich über Ernährung informiert werden?**
(Kreuze bitte alle passenden Antworten an!)

- ☐ Schulunterricht
- ☐ Eltern / Erwachsene
- ☐ Freunde/innen
- ☐ Bücher / Zeitschriften
- ☐ Unbewusst (Werbung)
- ☐ Fernsehen
- ☐ Internet
- ☐ Soziale Netzwerke
- ☐ Apps
- ☐ Digitale Spiele (Smartphone, PC, Konsole)
- ☐ Keine Antwort trifft zu

1.4 **Möchtest Du, dass in der Schule über Ernährung gesprochen wird?**
(Kreuze bitte nur eine Antwort an!)

- ☐ Ja
- ☐ Nein

1.5 **Was machst Du häufig, wenn es Dir langweilig ist?**
(Kreuze bitte alle passenden Antworten an!)

- ☐ Essen
- ☐ Lesen
- ☐ Musik hören
- ☐ Fern schauen
- ☐ Sport machen
- ☐ Brettspiele / Kartenspiele
- ☐ Digitale Spiele (Smartphone, PC, Konsole)
- ☐ Soziale Netzwerke
- ☐ Keine Antwort trifft zu

1.6 **Was machst Du häufig, wenn Du Stress hast?**
(Kreuze bitte alle passenden Antworten an!)

- ☐ Essen
- ☐ Lesen
- ☐ Musik hören
- ☐ Fern schauen
- ☐ Sport machen
- ☐ Brettspiele / Kartenspiele
- ☐ Digitale Spiele (Smartphone, PC, Konsole)
- ☐ Soziale Netzwerke
- ☐ Keine Antwort trifft zu

1.7 **Von welchem Getränk trinkst Du am meisten?**
(Kreuze bitte nur eine Antwort an!)

- ☐ Tee
- ☐ Eistee
- ☐ Wasser
- ☐ Schorle
- ☐ Limonade / Softdrink
- ☐ Saft
- ☐ Sonstiges: _____
- ☐ Weiß nicht

1.8 **Welche Hauptmahlzeit isst Du am häufigsten?**
(Kreuze bitte nur eine Antwort an!)

- ☐ Nudelgericht
- ☐ Fischgericht
- ☐ Fleischgericht
- ☐ Fastfood / Fertiggericht
- ☐ Süßspeise
- ☐ Sonstiges: _____
- ☐ Weiß nicht

1.9 **Was ist Dein Lieblingsessen / -gericht?**
(Kreuze bitte nur eine Antwort an)

- ☐ _____
- ☐ Kein Lieblingsessen / -gericht
- ☐ Mehrere Lieblingsessen / -gericht

MUSTER

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EvaSys	Fragebogen für die Altersgruppe (AG) 14-17 Jahre	Electric Paper

1. Ernährungsfragen [Fortsetzung]

1.10 **Was trifft häufig auf Dich zu?**
(Kreuze bitte alle passenden Antworten an!)

Ich esse, wenn ich ...

- ☐ hungrig bin
- ☐ Lust habe, zu essen
- ☐ gelangweilt bin
- ☐ gestresst bin
- ☐ fröhlich bin
- ☐ traurig bin
- ☐ nur zu den Essenszeiten
- ☐ Keine Antwort trifft zu

1.11 **Was trifft am meisten auf Dich zu?**
(Kreuze bitte nur eine Antwort an!)

Zu Hause esse ich meistens ...

- ☐ am Esstisch
- ☐ auf meinem Zimmer
- ☐ vor dem Fernseher
- ☐ Ich esse zu Hause nicht
- ☐ Keine Antwort trifft zu

1.12 **Was trifft häufig auf Dich zu?**
(Kreuze bitte alle passenden Antworten an!)

Ich esse Obst / Gemüse, weil ...

- ☐ es mir schmeckt
- ☐ es gesund ist
- ☐ es schlank macht
- ☐ meine Eltern / Erwachsene es wollen
- ☐ meine Freunde/innen es essen
- ☐ Ich esse kein Obst / Gemüse
- ☐ Keine Antwort trifft zu

1.13 **Wie viele *Portionen* Obst und Gemüse sollte man täglich essen? (*Portion* = eine Handvoll)**
Kreuze bitte nur eine Antwort an!)

- ☐ 0 *Portionen*
- ☐ 1-2 *Portionen*
- ☐ 5 *Portionen*
- ☐ So viele *Portionen* wie man möchte
- ☐ Weiß nicht

1.14 **Weißt Du, was eine Lebensmittelpyramide ist?**
(Kreuze bitte nur eine Antwort an!)

- ☐ Ja
- ☐ Nein

1.15 **Wie oft sollte man Fisch pro Woche essen?**
(Kreuze bitte nur eine Antwort an!)

- ☐ Jeden Tag
- ☐ 1-2 Mal pro Woche
- ☐ 3-4 Mal pro Woche
- ☐ Weiß nicht

1.16 **Wie viele Kalorien [kcal] enthalten 100 g Zucker?**
(Kreuze bitte nur eine Antwort an!)

- ☐ 306 kcal
- ☐ 406 kcal
- ☐ 506 kcal
- ☐ Weiß nicht

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EvaSys	Fragebogen für die Altersgruppe (AG) 14-17 Jahre	Electric Paper

2. Spielefragen

2.1 **Welche Spiele spielst Du häufig?**
(Kreuze bitte alle passenden Antworten an!)

- ☐ Brettspiele / Kartenspiele
- ☐ Spiele im Freien / Ballspiele
- ☐ Digitale Spiele (PC, Konsole)
- ☐ Digitale Spiele (Smartphone, Apps)
- ☐ Ich spiele nicht
- ☐ Keine Antwort trifft zu

2.2 **Über welche Plattform(en) kommunizierst Du häufig?**
(Kreuze bitte alle passenden Antworten an!)

- ☐ Facebook
- ☐ WhatsApp
- ☐ SnapChat
- ☐ Instagram
- ☐ Twitter
- ☐ Andere Plattform: _____
- ☐ Ich kommuniziere über keine Plattform(en)

Wir möchten ein digitales Spiel (Smartphone, PC) entwickeln und brauchen dafür Deine Unterstützung. Mit den folgenden Antworten hilfst Du uns, ein gutes und interessantes Spiel zu entwickeln.

Zu Deiner Information: *Bei manchen Fragen musst Du Dich in den Spieler / die Spielerin versetzen. Hierbei soll das reale Verhalten des Spielers / der Spielerin (täglicher Obst- / Gemüseverzehr) auf das digitale Spiel über Ernährung übertragen werden.*

2.3 **Was dürften die anderen Nutzer in einem digitalen Spiel alles über Dich wissen?**
(Kreuze bitte alle passenden Antworten an!)

- ☐ Körpergröße
- ☐ Körpergewicht
- ☐ Essgewohnheiten
- ☐ Sportliche Aktivitäten
- ☐ Spieldaten (Punkte, Level)
- ☐ Keine Daten über mich
- ☐ Keine Antwort trifft zu

2.4 **Was dürften die Spielentwickler in einem digitalen Spiel alles über Dich wissen?**
(Kreuze bitte alle passenden Antworten an!)

- ☐ Körpergröße
- ☐ Körpergewicht
- ☐ Essgewohnheiten
- ☐ Sportliche Aktivitäten
- ☐ Spieldaten (Punkte, Level)
- ☐ Keine Daten über mich
- ☐ Keine Antwort trifft zu

2.5 **Welche Spielfigur würde Dir in einem digitalen Spiel am besten gefallen?**
(Kreuze bitte nur eine Antwort an!)

- ☐ Niedliches Tier (Kätzchen)
- ☐ Beeindruckendes Tier (Raubkatze)
- ☐ Fantasiefigur (Held, Ritter, Fee)
- ☐ Fantasietier (Furby, Tamagotchi)
- ☐ Mensch, der genauso alt ist wie ich
- ☐ Mensch, der älter ist als ich
- ☐ Andere Spielfigur: _____
- ☐ Keine Antwort trifft zu

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2. Spielefragen [Fortsetzung]

2.6 **Möchtest Du in einem digitalen Spiel Informationen über Ernährung erhalten?**
(Kreuze bitte nur eine Antwort an!)

☐ Ja ☐ Nein

2.7 **Auf welche Art und Weise würdest Du in einem digitalen Spiel etwas über Ernährung lernen wollen?**
(Kreuze bitte alle passenden Antworten an!)

☐ Durch Quizfragen ☐ Durch Lösen von Aufgaben ☐ Durch lustige Filme
☐ Durch Mitspieler/innen ☐ Andere Art: _____ ☐ Ich möchte nichts lernen

☐ Keine Antwort trifft zu

2.8 **Wie würdest Du Deine "echten" Daten in einem digitalen Spiel über Ernährung angeben?**
(Kreuze bitte nur eine Antwort an!)

Ich würde ...

☐ immer die Wahrheit angeben ☐ manchmal die Wahrheit angeben ☐ mir Daten ausdenken
☐ meine Daten beschönigen / besser machen ☐ Keine Daten

2.9 **Eva isst täglich Obst / Gemüse. Wie sollte sie in einem digitalen Spiel über Ernährung belohnt werden?**
(Kreuze bitte alle passenden Antworten an!)

Eva's Spielfigur sollte ...

☐ hüpfen und lachen ☐ bessere Fähigkeiten bekommen ☐ neue Outfits bekommen
☐ Punkte bekommen ☐ Auszeichnungen bekommen ☐ neue "Leben" bekommen
☐ Sonstige Belohnung: _____ ☐ Keine Belohnung

2.10 **Tim gewinnt in einem digitalen Spiel über Ernährung ein Quiz. Wie sollte er in diesem Spiel belohnt werden?**
(Kreuze bitte alle passenden Antworten an!)

Tim's Spielfigur sollte ...

☐ hüpfen und lachen ☐ bessere Fähigkeiten bekommen ☐ neue Outfits bekommen
☐ Punkte bekommen ☐ Auszeichnungen bekommen ☐ neue "Leben" bekommen
☐ Sonstige Belohnung: _____ ☐ Keine Belohnung

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2. Spielefragen [Fortsetzung]

2.11 **Lea isst normalerweise viel Obst / Gemüse. Diese Woche hat sie sehr viel Fastfood gegessen. Wie sollte sich dadurch ihre Spielfigur in einem digitalen Spiel verändern?**
(Kreuze bitte nur eine Antwort an!)

Lea's Spielfigur sollte ...

- ☐ dünner werden
- ☐ dicker werden
- ☐ schneller werden
- ☐ langsamer werden
- ☐ stärker werden
- ☐ schwächer werden
- ☐ Sonstige Veränderung: _____
- ☐ Keine Veränderung

2.12 **In einem digitalen Spiel zum Thema "Ernährung" sollen Ziele gemeinsam in einem Team erreicht werden. Wer sollten die Spieler in diesem Team sein?**
(Kreuze bitte alle passenden Antworten an!)

- ☐ Familienmitglieder
- ☐ Freunde/innen
- ☐ Personen mit gleichen Hobbies
- ☐ Personen mit gleichen Essgewohnheiten
- ☐ Personen ohne Gemeinsamkeiten
- ☐ Anderes Team: _____
- ☐ Kein Team

2.13 **Spielst Du digitale Spiele (Smartphone, PC, Konsole, Apps)?**
(Kreuze bitte nur eine Antwort an!)

- ☐ Ja
- ☐ Nein

2.14 **Wann spielst Du häufig digitale Spiele?**
(Kreuze bitte alle passenden Antworten an!)

Wenn ich ...

- ☐ Lust habe
- ☐ fröhlich bin
- ☐ traurig bin
- ☐ gelangweilt bin
- ☐ bei Freunden/innen bin
- ☐ alleine zu Hause bin
- ☐ unterwegs bin
- ☐ in der Schule bin
- ☐ Andere Situation: _____
- ☐ Ich spiele nicht
- ☐ Weiß nicht

2.15 **Wie oft spielst Du digitale Spiele am PC / auf der Konsole?**
(Kreuze bitte nur eine Antwort an!)

- ☐ 1-2 Mal / Tag
- ☐ 3-5 Mal / Tag
- ☐ 6-10 Mal / Tag
- ☐ Mehr als 10 Mal / Tag
- ☐ Mehrmals in der Woche
- ☐ Mehrmals im Monat
- ☐ Ich spiele nicht
- ☐ Weiß nicht

2.16 **Wie oft spielst Du digitale Spiele auf dem Smartphone / Tablett / Apps?**
Kreuze bitte nur eine Antwort an!)

- ☐ 1-2 Mal / Tag
- ☐ 3-5 Mal / Tag
- ☐ 6-10 Mal / Tag
- ☐ Mehr als 10 Mal / Tag
- ☐ Mehrmals in der Woche
- ☐ Mehrmals im Monat
- ☐ Ich spiele nicht
- ☐ Weiß nicht

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2. Spielefragen [Fortsetzung]

2.17 **Wie lange spielst Du ohne Unterbrechung digitale Spiele am PC / auf der Konsole?**
(Kreuze bitte nur eine Antwort an!)

- ☐ < 5 Minuten
- ☐ ~ 5 Minuten
- ☐ ~ 15 Minuten
- ☐ ~ 30 Minuten
- ☐ ~ 60 Minuten
- ☐ > 60 Minuten
- ☐ Ich spiele nicht
- ☐ Weiß nicht

2.18 **Wie lange spielst Du ohne Unterbrechung digitale Spiele auf dem Smartphone / Tablet / Apps?**
(Kreuze bitte nur eine Antwort an!)

- ☐ < 5 Minuten
- ☐ ~ 5 Minuten
- ☐ ~ 15 Minuten
- ☐ ~ 30 Minuten
- ☐ ~ 60 Minuten
- ☐ > 60 Minuten
- ☐ Ich spiele nicht
- ☐ Weiß nicht

2.19 **Mit wie vielen Spielern (im Spiel) spielst Du am liebsten gleichzeitig digitale Spiele?**
(Kreuze bitte nur eine Antwort an!)

- ☐ Mit 2-5 Spielern
- ☐ Mit 6-10 Spielern
- ☐ Mit mehr als 10 Spielern
- ☐ Alleine
- ☐ Ich spiele nicht
- ☐ Weiß nicht

2.20 **Was gefällt Dir in digitalen Spielen?**
(Kreuze bitte alle passenden Antworten an!)

- ☐ Höhere Level freischalten
- ☐ Punkte sammeln
- ☐ Mit Freunden/innen Zeit verbringen
- ☐ Mit Freunden/innen Ziele erreichen
- ☐ Ereignisse in einer Fantasiewelt lenken
- ☐ Im Wettkampf siegen
- ☐ Sonstiges: _____
- ☐ Ich spiele nicht
- ☐ Weiß nicht

2.21 **Welches digitale Spiel spielst Du am häufigsten (Name des Spiels)?**
Bitte leserlich schreiben!

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3. Zu Deiner Person

3.1 **Wie alt bist Du?** [Jahre]

3.2 **Welches Geschlecht hast Du?**

☐ Mädchen ☐ Junge

3.3 **Auf welche Schule gehst Du?**

☐ Mittelschule / Hauptschule ☐ Realschule ☐ Gymnasium
☐ Berufsschule ☐ Sonstige

3.4 **Mit wem wohnst Du zusammen?**

☐ Mit beiden Elternteilen / meinen Geschwistern
☐ Mit meiner Mutter / meinen Geschwistern
☐ Mit meinem Vater / meinen Geschwistern
☐ Mit meiner Stiefmutter, meinem Vater / meinen Geschwistern
☐ Mit meinem Stiefvater, meiner Mutter / meinen Geschwistern
☐ Ich wohne alleine
☐ Andere Wohnsituation

3.5 **Wie groß bist du?** (Meter [m])

3.6 **Wie viel wiegst Du?** (Kilogramm [kg])

4. Deine Kommentare

4.1 Hast Du noch Anmerkungen oder Vorschläge für Ergänzungen? Hattest Du Schwierigkeiten bei bestimmten Fragen? Hier hast Du Platz, Deine spontanen Eindrücke zu äußern. Wir sind für jede Anregung dankbar.

Datum: _____

Vielen Dank für Deine Teilnahme an unserer Umfrage!!!

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A2 – Questionnaire for *Young Adults*

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Testumfrage		TUM

Bitte so markieren: ☐ ☒ ☐ ☐ ☐ Bitte verwende einen Kugelschreiber oder nicht zu starken Filzstift. Dieser Fragebogen wird maschinell erfasst.
Korrektur: ☐ ■ ☐ ☒ ☐ Bitte beachte für eine optimale Datenerfassung die links aufgezeigten Hinweise beim Ausfüllen und Korrigieren.

Liebe Teilnehmerin, lieber Teilnehmer,

das Institut für Ernährungsmedizin möchte die Ernährungsinformation von Erwachsenen im Alter zwischen 18 und 24 Jahren mittels digitaler Lernspiele verbessern. Hierzu führen wir Befragungen zum Ernährungs- und digitalen Spielverhalten durch.

Die Beantwortung der Fragen dauert fünf bis zehn Minuten. Bitte beachte bei jeder Frage den Hinweis, ob eine oder alle passenden Antworten ausgewählt werden sollen.

Die Teilnahme an der Befragung ist freiwillig. Wir erheben die Daten anonym, also ohne Rückschlussmöglichkeit auf Deine Person. Wir versichern, dass die Daten vertraulich behandelt werden. Die Rohdaten werden nicht an Dritte weitergegeben, die Ergebnisse können in aggregierter Form im Rahmen von Forschungsarbeiten veröffentlicht werden. Für die Teilnahme an der Befragung lies Dir bitte den nachfolgenden Absatz "Einwilligungserklärung" sorgfältig durch.

Einwilligungserklärung (Datenschutz)

Mit Beantwortung der nachstehenden Fragen gebe ich meine freiwillige Einwilligung zur anonymisierten Verwendung meiner Antworten. Ich bin damit einverstanden, dass meine Angaben anonymisiert ausgewertet und veröffentlicht werden. Dabei sind keine Rückschlüsse auf einzelne TeilnehmerInnen möglich. Die Arbeit dient allein dem wissenschaftlichen Interesse und Zwecke.

Wir freuen uns über und danken für Deine Teilnahme.

Weitere Informationen zu unserem Forschungsprojekt findest Du unter www.enable-cluster.de.

Dein Umfrage - Team

1. Fragen zu Deiner Person

1.1 Wie alt bist Du? ☐ 18-19 Jahre ☐ 20-21 Jahre ☐ 22-24 Jahre ☐ >24 Jahre

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2. Ernährungsfragen

2.1 **Welche Veränderung(en) wünschst Du Dir rund um das Thema "Ernährung"?**
(Wähle bitte alle passenden Antworten aus!)

Ich wünsche mir ...

- ☐ zu Hause Obst / Gemüse
- ☐ in der Mensa / Kantine Obst / Gemüse
- ☐ zu Hause Süßigkeiten
- ☐ in der Mensa / Kantine Süßigkeiten
- ☐ zu Hause Fastfood / Fertigprodukte
- ☐ in der Mensa / Kantine Fastfood / Fertigprodukte
- ☐ Kocherlebnisse mit Partner/in, Familie & Freunden/innen
- ☐ Kochrezepte / Kochkurse
- ☐ Informationen über Ernährung
- ☐ Sonstige Veränderung(en)
- ☐ Keine Veränderung(en)

2.2 **Wo wirst Du über Ernährung informiert / Wo informierst Du Dich über Ernährung?**
(Wähle bitte alle passenden Antworten aus!)

- ☐ Uni / Arbeit
- ☐ Partner/in & Familie
- ☐ Freunde/innen
- ☐ Bücher / Zeitschriften
- ☐ Unbewusst (Werbung)
- ☐ Fernsehen
- ☐ Internet
- ☐ Soziale Netzwerke
- ☐ Apps
- ☐ Digitale Spiele (Smartphone, PC, Konsole)
- ☐ Keine Antwort trifft zu

2.3 **Wo willst Du zusätzlich über Ernährung informiert werden?**
(Wähle bitte alle passenden Antworten aus!)

- ☐ Uni / Arbeit
- ☐ Partner/in & Familie
- ☐ Freunde/innen
- ☐ Bücher / Zeitschriften
- ☐ Unbewusst (Werbung)
- ☐ Fernsehen
- ☐ Internet
- ☐ Soziale Netzwerke
- ☐ Apps
- ☐ Digitale Spiele (Smartphone, PC, Konsole)
- ☐ Keine Antwort trifft zu

2.4 **Möchtest Du, dass in der Uni / Arbeit über das Thema "Ernährung" gesprochen wird?**
(Wähle bitte nur eine Antwort aus!)

- ☐ Ja
- ☐ Nein

2.5 Über welche "Ernährungsbezogenen Themen" möchtest Du informiert werden?
(Wähle bitte alle passenden Antworten aus!)

- ☐ Gewichtsmanagement (z.B. Abnehmen)
- ☐ Lebensmittelbedingte Risiken
- ☐ Ernährungstrends (z.B. Vegan)
- ☐ Gesundheitswert vonLebensmitteln
- ☐ Unverträglichkeiten (z.B. Milch)
- ☐ Gesundheitswert von Lebensmitteln
- ☐ Ernährungsbedingte Krankeiten
- ☐ Sonstiges
- ☐ Ich habe kein Interesse

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2. Ernährungsfragen [Fortsetzung]

2.6 **Was machst Du häufig, wenn es Dir langweilig ist?**
(Wähle bitte alle passenden Antworten aus!)

- ☐ Essen
- ☐ TV
- ☐ Digitale Spiele (Smartphone, PC, Konsole)
- ☐ Lesen
- ☐ Sport / Spaziergang
- ☐ Soziale Netzwerke
- ☐ Musik hören
- ☐ Brettspiele / Kartenspiele
- ☐ Keine Antwort trifft zu

2.7 **Was machst Du häufig, wenn Du gestresst bist?**
(Wähle bitte alle passenden Antworten aus!)

- ☐ Essen
- ☐ TV
- ☐ Digitale Spiele (Smartphone, PC, Konsole)
- ☐ Lesen
- ☐ Sport / Spaziergang
- ☐ Soziale Netzwerke
- ☐ Musik hören
- ☐ Brettspiele / Kartenspiele
- ☐ Keine Antwort trifft zu

2.8 **Von welchem Getränk (ohne Alkohol) trinkst Du am meisten?**
(Wähle bitte nur eine Antwort aus!)

- ☐ Tee
- ☐ Schorle
- ☐ Sonstiges
- ☐ Eistee
- ☐ Limonade / Softdrink
- ☐ Weiß nicht
- ☐ Wasser
- ☐ Saft

2.9 **Welche Mahlzeit isst Du am häufigsten?**
(Wähle bitte nur eine Antwort aus!)

- ☐ Nudelgericht
- ☐ Fastfood / Fertiggericht
- ☐ Weiß nicht
- ☐ Fischgericht
- ☐ Süßspeise
- ☐ Fleischgericht
- ☐ Sonstiges

2.10 **Was ist Dein Lieblingsessen / -gericht?**

2.11 **Was trifft häufig auf Dich zu?**
(Wähle bitte alle passenden Antworten aus!)

Ich esse, wenn ich ...

- ☐ hungrig bin
- ☐ gestresst bin
- ☐ nur zu den Essenszeiten
- ☐ Lust habe, zu essen
- ☐ gut gelaunt bin
- ☐ Keine Antwort trifft zu
- ☐ gelangweilt bin
- ☐ traurig bin

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2. Ernährungsfragen [Fortsetzung]

2.12 **Was trifft <u>am meisten</u> auf Dich zu?**
(Wähle bitte nur <u>eine</u> Antwort aus!)

Zu Hause esse ich meistens ...

- ☐ am Esstisch
- ☐ in meinem Zimmer
- ☐ vor dem Fernseher
- ☐ Ich esse zu Hause nicht
- ☐ Keine Antwort trifft zu

2.13 **Was trifft häufig auf Dich zu?**
(Wähle bitte <u>alle</u> passenden Antworten aus!)

Ich esse Obst / Gemüse, weil ...

- ☐ es mir schmeckt
- ☐ es gesund ist
- ☐ es schlank macht
- ☐ mein(e) Partner/in & Familie es will
- ☐ meine Freunde/innen es essen
- ☐ es angeboten wird (z.B. Obst / Salat im Mittagsmenü)
- ☐ Ich esse kein Obst / Gemüse
- ☐ Keine Antwort trifft zu

2.14 **Weißt Du, was eine Lebensmittelpyramide ist?**
(Wähle bitte nur <u>eine</u> Antwort aus!)

- ☐ Ja
- ☐ Nein

2.15 **Wie häufig kochst Du (alleine / gemeinsam)?**
(Wähle bitte nur <u>eine</u> Antwort aus!)

- ☐ täglich
- ☐ mehrmals pro Woche
- ☐ einmal pro Woche
- ☐ Ich koche nicht
- ☐ Weiß nicht

2.16 **Deine Idee(n) zur Vermittlung von Ernährungswissen / Ernährungskommunikation?**

3. Spielefragen

3.1 **Welche Spiele spielst Du häufig?**
(Wähle bitte <u>alle</u> passenden Antworten aus!)

- ☐ Brettspiele / Kartenspiele
- ☐ Spiele im Freien (z.B. Volleyball)
- ☐ Digitale Spiele (PC, Konsole)
- ☐ Digitale Spiele (Smartphone, Apps)
- ☐ Ich spiele nicht
- ☐ Keine Antwort trifft zu

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3. Spielefragen [Fortsetzung]

3.2 **Über welche Plattform(en) kommunizierst Du häufig?**
(Wähle bitte alle passenden Antworten aus!)

- ☐ Facebook
- ☐ WhatsApp
- ☐ SnapChat
- ☐ Instagram
- ☐ Twitter
- ☐ Andere Plattform
- ☐ Ich kommuniziere über keine Plattform(en)

Wir möchten ein digitales Spiel (Smartphone, PC) entwickeln und brauchen dafür Deine Unterstützung. Mit den folgenden Antworten hilfst Du uns, ein gutes und interessantes Spiel zu entwickeln.

Zu Deiner Information: *Bei manchen Fragen sollst Du Dich in den Spieler / die Spielerin versetzen. Hierbei soll das reale Verhalten des Spielers / der Spielerin (täglicher Obst- / Gemüseverzehr) auf das digitale Spiel über Ernährung übertragen werden.*

3.3 **Was dürften die anderen Nutzer in einem digitalen Spiel alles über Dich wissen?**
(Wähle bitte alle passenden Antworten aus!)

- ☐ Körpergröße
- ☐ Körpergewicht
- ☐ Essgewohnheiten
- ☐ Sportliche Aktivitäten
- ☐ Spieldaten (Punkte, Level)
- ☐ Keine Daten über mich
- ☐ Keine Antwort trifft zu

3.4 **Was dürften die Spielentwickler in einem digitalen Spiel alles über Dich wissen?**
(Wähle bitte alle passenden Antworten aus!)

- ☐ Körpergröße
- ☐ Körpergewicht
- ☐ Essgewohnheiten
- ☐ Sportliche Aktivitäten
- ☐ Spieldaten (Punkte, Level)
- ☐ Keine Daten über mich
- ☐ Keine Antwort trifft zu

3.5 **Welche Spielfigur würde Dir in einem digitalen Spiel am besten gefallen?**
(Wähle bitte nur eine Antwort aus!)

- ☐ Süßes Tier (Kätzchen)
- ☐ Gefährliches Tier (Tiger)
- ☐ Fantasiefigur (Held, Ritter, Fee)
- ☐ Fantasietier (Furby, Tamagotchi)
- ☐ Mensch, der genauso alt ist wie ich
- ☐ Mensch, der älter ist als ich
- ☐ Mensch, der jünger ist als ich
- ☐ Andere Spielfigur
- ☐ Keine Antwort trifft zu

3.6 **Möchtest Du in einem digitalen Spiel Informationen über Ernährung erhalten?**
(Wähle bitte nur eine Antwort aus!)

- ☐ Ja
- ☐ Nein

3.7 **Wie findest Du die Übertragung der Wirklichkeit in ein digitales Spiel wie bei der App "Pokémon Go!" ?**
(Wähle bitte nur eine Antwort aus!)

- ☐ Gut
- ☐ Schlecht
- ☐ Weiß nicht

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3. Spielefragen [Fortsetzung]

3.8 **Auf welche Art und Weise würdest Du in einem digitalen Spiel etwas über Ernährung lernen wollen?**
(Wähle bitte alle passenden Antworten aus!)

- ☐ Durch Quizfragen
- ☐ Durch Lösen von Aufgaben
- ☐ Durch lustige Filme
- ☐ Durch Mitspieler/innen
- ☐ Andere Art
- ☐ Ich möchte nichts lernen
- ☐ Keine Antwort trifft zu

3.9 **Wie würdest Du Deine "echten" Daten in einem digitalen Spiel über Ernährung angeben?**
(Wähle bitte nur eine Antwort aus!)

Ich würde ...

- ☐ immer die Wahrheit angeben
- ☐ manchmal die Wahrheit angeben
- ☐ mir Daten ausdenken
- ☐ meine Daten beschönigen / besser machen
- ☐ Keine Daten

3.10 **Julia isst täglich Obst / Gemüse. Wie sollte sie in einem digitalen Spiel über Ernährung belohnt werden?**
(Wähle bitte alle passenden Antworten aus!)

Julia's Spielfigur sollte ...

- ☐ Spielgeld erhalten
- ☐ bessere Fähigkeiten bekommen
- ☐ neue Outfits bekommen
- ☐ Punkte bekommen
- ☐ Auszeichnungen bekommen
- ☐ neue "Leben" bekommen
- ☐ Sonstige Belohnung
- ☐ Keine Belohnung

3.11 **Max gewinnt in einem digitalen Spiel über Ernährung ein Quiz. Wie sollte er in diesem Spiel belohnt werden?**
(Wähle bitte alle passenden Antworten aus!)

Max's Spielfigur sollte ...

- ☐ Spielgeld erhalten
- ☐ bessere Fähigkeiten bekommen
- ☐ neue Outfits bekommen
- ☐ Punkte bekommen
- ☐ Auszeichnungen bekommen
- ☐ neue "Leben" bekommen
- ☐ Sonstige Belohnung
- ☐ Keine Belohnung

3.12 **Julia isst normalerweise viel Obst / Gemüse. Diese Woche hat sie sehr viel Fastfood gegessen. Wie sollte sich dadurch ihre Spielfigur in einem digitalen Spiel verändern?**
(Wähle bitte nur eine Antwort aus!)

Julia's Spielfigur sollte ...

- ☐ dünner werden
- ☐ dicker werden
- ☐ schneller werden
- ☐ langsamer werden
- ☐ stärker werden
- ☐ schwächer werden
- ☐ Sonstige Veränderung
- ☐ Keine Veränderung

3.13 **In einem digitalen Spiel zum Thema "Ernährung" sollen Ziele gemeinsam in einem Team erreicht werden. Wer sollten die Spieler in diesem Team sein?**
(Wähle bitte alle passenden Antworten aus!)

- ☐ Partner/in & Familie
- ☐ Freunde/innen
- ☐ Personen mit gleichen Hobbies
- ☐ Personen mit gleichen Essgewohnheiten
- ☐ Personen ohne Gemeinsamkeiten
- ☐ Anderes Team
- ☐ Kein Team

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3. Spielefragen [Fortsetzung]

3.14 **Spielst Du digitale Spiele (Smartphone, PC, Konsole, Apps)?**
(Wähle bitte nur eine Antwort aus!)

☐ Ja ☐ Nein

3.15 **Wann spielst Du häufig digitale Spiele?**
(Wähle bitte alle passenden Antworten aus!)

Wenn ich ...

☐ Lust habe	☐ gut gelaunt bin	☐ traurig bin
☐ gelangweilt bin	☐ bei Freunden/innen bin	☐ alleine zu Hause bin
☐ unterwegs bin	☐ in der Uni / Arbeit bin	☐ Andere Situation
☐ Ich spiele nicht	☐ Weiß nicht	

3.16 **Wie oft spielst Du digitale Spiele am PC / auf der Konsole?**
(Wähle bitte nur eine Antwort aus!)

☐ 1 - 2 Mal / Tag	☐ 3 - 5 Mal / Tag	☐ 6 - 10 Mal / Tag
☐ Mehr als 10 Mal / Tag	☐ Mehrmals in der Woche	☐ Mehrmals im Monat
☐ Ich spiele nicht	☐ Weiß nicht	

3.17 **Wie oft spielst Du digitale Spiele auf dem Smartphone / Tablet / Apps?**
(Wähle bitte nur eine Antwort aus!)

☐ 1 - 2 Mal / Tag	☐ 3 - 5 Mal / Tag	☐ 6 - 10 Mal / Tag
☐ Mehr als 10 Mal / Tag	☐ Mehrmals in der Woche	☐ Mehrmals im Monat
☐ Ich spiele nicht	☐ Weiß nicht	

3.18 **Wie lange spielst Du ohne Unterbrechung digitale Spiele am PC / auf der Konsole?**
(Wähle bitte nur eine Antwort aus!)

☐ < 5 Minuten	☐ ~ 5 Minuten	☐ ~ 15 Minuten
☐ ~ 30 Minuten	☐ ~ 60 Minuten	☐ > 60 Minuten
☐ Ich spiele nicht	☐ Weiß nicht	

3.19 **Wie lange spielst Du ohne Unterbrechung digitale Spiele auf dem Smartphone / Tablet / Apps?**
(Wähle bitte nur eine Antwort aus!)

☐ < 5 Minuten	☐ ~ 5 Minuten	☐ ~ 15 Minuten
☐ ~ 30 Minuten	☐ ~ 60 Minuten	☐ > 60 Minuten
☐ Ich spiele nicht	☐ Weiß nicht	

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3. Spielefragen [Fortsetzung]

3.20 **Mit wie vielen Spielern (im Spiel) spielst Du <u>am liebsten</u> gleichzeitig digitale Spiele?**
(Wähle bitte nur <u>eine</u> Antwort aus!)

- ☐ Mit 2 - 5 Spielern
- ☐ Mit 6 - 10 Spielern
- ☐ Mit mehr als 10 Spielern
- ☐ Alleine
- ☐ Ich spiele nicht
- ☐ Weiß nicht

3.21 **Was gefällt Dir in digitalen Spielen?**
(Wähle bitte <u>alle</u> passenden Antworten aus!)

- ☐ Höhere Level freischalten
- ☐ Punkte sammeln
- ☐ Mit Freunden/innen Zeit verbringen
- ☐ Mit Freunden/innen Ziele erreichen
- ☐ Ereignisse in einer Fantasiewelt lenken
- ☐ Im Wettkampf siegen
- ☐ Sonstiges
- ☐ Ich spiele nicht
- ☐ Weiß nicht

3.22 **Welches digitale Spiel spielst Du am häufigsten (Name des Spiels)?**

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4. Zu Deiner Person

4.1 **Wie alt bist Du?** [Jahre]

4.2 **Welches Geschlecht hast Du?**
(Wähle bitte nur eine Antwort aus!)

☐ weiblich ☐ männlich

4.3 **Wie ist Deine berufliche Situation?**
(Wähle bitte nur eine Antwort aus!)

☐ Arbeitnehmer/in ☐ Student/in ☐ Auszubildende/r
☐ Sonstiges

4.4 **Wie lautet die genaue Bezeichnung Deines (zukünftigen) Berufs bzw. Studiengangs?**

4.5 **Wie ist Deine Wohnsituation?**
(Wähle bitte nur eine Antwort aus!)

☐ Alleine ☐ Wohngemeinschaft (WG) ☐ Zuhause, Partner/in & Familie
☐ Andere Wohnsituation

4.6 **Wie groß bist du?** (Meter [m])

4.7 **Wie viel wiegst Du?** (Kilogramm [kg])

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5. Deine Kommentare

5.1

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