

Evaluating an adaptive intervention in collaboration scripts deconstructing body image narratives in a social media educational platform

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Abstract. Social Media is an important disseminator of body image representations and the body cult. The growing popularity of social media among children and adolescents makes minors a vulnerable group to the internalization of body ideals and stereotypes. Developing educational interventions that provide adolescents with skills to better understand the body image in social media is therefore necessary to counteract the effects of deceitful representations and discourse. This paper evaluates an adaptive educational intervention to define the suitable approach to teach adolescents about body image and stereotyping in social media. In particular, the paper examines and compares three approaches to identify the dominant body image stereotype in students' social media: The self-reported methods, the analysis of social preferences, and the use of xAPI to track users' behavior. Results showed that the use of xAPI combined with self-reported answers can provide better input from adolescents' preferences. Moreover, it allows the automatic distribution of suitable counter-narratives to students participating in computer-supported collaborative learning activities embedded in an educational social media platform.

Keywords: social media, digital skills, self-protection skills, CSCL scripts, counter-narratives.

1 Introduction

Social media platforms are important mediators in the construction of youngsters' body image [1]. While liking, tagging, and sharing social media posts, youngsters are exposed to different types of content, including representations that normalize the body ideals and stereotypes [2]. Image exposure and content interaction can reinforce the negative attitudes and perceptions that affect youngsters' body image [3,4,5], which can lead teenagers to experience body image dissatisfaction [6]. While some experts argue stronger regulations and even prohibition may be a solution [7], the media education of adolescents towards the uses and implications of social media may also be a fair measure [8,9].

Developing ad hoc interventions can help children protect themselves, especially when raising awareness for the well-being is spoiled by both psychological and cultural factors [10]. One exemplary intervention is the one promoted by the use of narrative scripts (NS) [11] a combination of CSCL and story-telling techniques. As a pedagogical approach, NSs has been defined as an opportunity to raise awareness by situating young users into social media tailored risk scenarios and empowering their critical thinking attitudes.

NSs seek to provide students with learning material based on their own social media experiences. Nevertheless, to meet students' experience, NSs must cope with students' social media reality; for instance, preferences, patterns of interaction, time of exposure, etc. Adapting learning content to the user's behavior is not a new topic in research as adaptive learning systems have been on the forefront for some years now. Adaptive learning technologies (ALT) collect data based on the students' performance and behavior, and provide them with personalized learning materials and feedback. Integrating ALT to body image literacy can contribute to a better understanding of body image discourse and stereotypes by providing students with learning material based on the stereotypes they are exposed to.

In the topic of body image, ALT has yet to explore techniques to identify students' body image stereotypes. As the use of social media among adolescents is constantly growing and it can pose a threat to their body image perception, we find it important to explore this line of work. Therefore, the aim of this study is to explore different techniques to determine the students' dominant stereotypes in the topic of body image in order to facilitate the creation of CSCL activities.

1.1 Adaptive Learning Technology and CSCL scripts for a Social Media Literacy intervention

ALT is considered an emerging educational technological innovation [12]. It has pedagogical benefits, including acceleration, remediation, metacognition, mastery-based learning, immediate feedback and interactive learning [13] The Horizon Report (2018) explains that adaptive learning occurs when digital tools and systems are used to create individual learning paths for students based on their strengths, weakness and pace of learning however some adaptive learning systems include profile information from other sources [14].

One of the key components of Adaptive Learning is the learner model. The learner model refers to a student's representation as observed by an intelligent tutor. It collects data related to the student's behavior and performance within a virtual platform and reasons about adjusting feedback [15]. Besides collecting data related to the learning progress (activities, material, performance) ALT is also capable of identifying students' personality traits based on their behavior and performance. Research on personality traits and ALT saw the implementation of systems capable of understanding students cognitive and affective states [16]. In the topic of body image, ALT has yet to explore techniques to identify students' dominant stereotypes. As the use of social media among

adolescents is constantly growing and it can pose a threat to their body image perception, we find it important to explore this line of work.

CSCL scripts structure a collaborative learning flow (group formation, sequence of tasks, role rotation, etc.) to facilitate the triggering of desired social interactions leading to fruitful learning by defining the task structure, the time structure, and the social structure of the collaborative activities [17]. Some of its applications include organizing collaboration by grouping students with different opinions to work on a task (ArgueGraph [18]), distributing information between participants for later discussion and explanation (jigsaw CLFP) and achieving consensus between participants by progressive knowledge building (Pyramid CLFP). ALT has been integrated in the design of CSCL systems to maximize the user-tailored support provided to group learners, focusing both on improved domain learning and the development of collaboration skills. The potential benefits of ALT in CSCL are high, by analyzing the user traits and characteristics a better group formation and knowledge distribution can be achieved or even adapting the activity to the group collaboration in real-time [19].

1.2 Exploring approaches for the detection of body image dominant stereotypes

Acquiring information about the learner model is often related with machine learning techniques, however for the identification of personality traits non-machine learning approaches are also used. A few such approaches have seen the use of pattern recognition techniques, self-labeling, questionnaires, and in some cases a combination of the two approaches has been applied [20,21,22]. In this section, we will identify existing approaches that are currently used in the topic of body image to identify the existence of stereotypes primarily outside the area of adaptive learning.

The use of questionnaires appears to be a preferred method in media literacy studies to identify stereotypes in social media. The study by Verrastro et al. [23] saw the implementation of a set of questionnaires on the topic of Instagram use and body-related scales to study the relationship between the use of Instagram, the internalization of beauty standards, the social pressure to adhere to them, and anxiety towards body image. Other approaches saw the implementation of open and self-reported answers to understand potential stereotypes. One such approach is the one described by Niemann et al. [24]. They performed a cluster analysis on a set of open-answers given by students in a survey about adjectives associated with demographic groups. According to them “findings indicate that open-ended responses, although laborious to organize, can be successfully employed for stereotype research”. Despite being a laborious work, the use of self-reported answers has the potential to provide insights about users’ preferences in social media as it receives a direct input from the users.

A more complex approach saw a content analysis to understand stereotypes that appeared within Instagram profiles. Butkowski et al [25] studied how the stereotypical gender display was presented in young adult women’s Instagram selfies, due to the complexity of the task they performed a content analysis using a manual coding scheme to classify the different variables (type of pose, expressed emotions, amount of body

display) and a quantitative analysis of the feedback of the studied selfies (number of likes and comments).

As the use of questionnaires and content analysis will only provide us with input based on the result of a one-time analysis, we further explored possibilities of implementing approaches that would collect information based on the user's behavior. We identified a previous work that has attempted to extract data from social networks using web scraping tools and store it in a Learning Record Storage using the experience API (xAPI) data structure enabling teachers to create different learning activities based on the student's behavior [26].

The xAPI is a community-driven specification for learning technology. It was born from applying the Activity Streams concept to e-learning [27]. It defines both data and communication models to track user activities within learning software applications and has been used in different learning scenarios, such as serious games [28], online learning [29] and self-regulated learning [30]. In xAPI each event is captured as a statement, that is formed as a sentence with an actor (student token id), verb (action performed), activity (object) and context (time, session id, environment), that is stored chronologically in JSON format. The flexibility of xAPI allows the inclusion of different types of variables in the statements and the wide vocabulary of verbs already contains the most used social networks interactions allowing us to successfully track all the student's actions inside the educational social media platform.

The use of an appropriate method to identify students body image stereotypes will allow educators to provide students with material to counter possible toxic body ideals that arise. One of the strongest components of implementing ALT for raising awareness of body image stereotypes is the implementation of counter-narratives [31]. The implementation of counter-narratives within a social media can take advantage of different factors such as the allocation of participants into different scenarios based on their content preferences and interactions. As participants get involved in different interaction patterns while using social media, counter-narratives can be adapted to the personal interests and learning needs of young users.

Considering to date no study has considered this approach to examine students' interaction with body image content, the aim of this work is to explore different techniques to categorize learners based on the students' dominant stereotypes in the topic of body image. To do that, we pursued these specific objectives:

- O1. Analyze teens' social media use and content preferences.
- O2. Identify teens' exposure to body image content.
- O3. Observe and analyze teens' SM interactions/online behavior within the designed educational platform.

2 Method

2.1 Study design and Sample

This study explored three approaches to determine the dominant stereotype that students may have when exploring social media. The data for these approaches were gathered during two sessions (4 hours) of digital literacy workshops carried out in three

schools. During these sessions, 186 students ($n = 186$; 87 male, 88 female, and 11 undefined; Ages 13 to 16, mean age = 13.9, $SD = 0.74$) answered a questionnaire, registered to an educational social media platform and accessed a narrative script that covered different topics of threats and dangers that exist within social media. The workshops took place during school hours and therefore the students were placed in their assigned classrooms.

For this study, an initial focus was made on beauty and body stereotypes that can be created by influencers on Instagram. A narrative script has been designed to expose the reality behind the curated content of influencers falling under the categories of beauty and fitness.

The categories of beauty and fitness have been chosen as they target the topic of idealized body image that immensely exists in social media platforms. We have classified as beauty influencers, accounts that tend to share content related to make-up tutorials, high fashion, and modeling. The category of fitness includes accounts that focus on idealized body image, muscles, workouts and diets.

The third category of neutral influencers has also been considered to act as a gateway in case a student does not show a particular interest in the aforementioned categories. The neutral influencers refer to influencers that do not promote a specific beauty or body stereotype and are more focused on music, games, or traveling.

2.2 Measurement and Instruments

The research design was embedded in two sessions of the digital literacy workshops, participants were requested to perform different tasks and answered a questionnaire expressly designed for this study. Then they registered and navigated in a simulated educational social network, that was preloaded with profiles and photos that had the narratives of fitness, beauty, and neutral, but were not different from a regular profile to not bias the student's perception. In total 16 female and male predefined influencer profiles were created; 4 fitness profiles, 4 beauty profiles, and 8 neutral profiles.

Each of the interactions with the preloaded content was stored using the xAPI structure using the verbs liked, commented, opened (a specific profile), viewed (a specific photo) followed (a specific profile), and comment (a photo). In addition, each predefined profile was assigned a category that was captured by the xAPI.

The preloaded content was displayed within the same timeline as the student's content. Taking into consideration that some curiosity could rise as to who this person is, we considered assigning data weights to each xAPI verb to minimize curiosity from hindering the user's real preferences. The data weights were assigned to reflect the level of interest in each action. For the above verbs the following weights were considered; user viewed an image or video, 1 point, user liked or commented on a photo or video, 2 points, a user opened a profile page, 4 points, and finally, if a user followed a profile, 6 points were awarded.

For the purpose of this study, we focused on three variables:

- Social Media Use: measured from the questionnaire by asking the students about the top influencers that they followed.

- **Body Image Source of Information:** measured from the questionnaire through a list of topics and information sources.
- **Online behavior:** this variable was observed through the data captured using xAPI when students interacted with the predefined influencer profiles.

2.3 Procedure

At the beginning of the first workshop session, students answered a set of questions where they selected which sources of information, they use to get information about the topics of fitness and beauty. The questions included which sources (social media, friends and family, advertisement, TV and other communication media, experts on the topic) they use to keep up with topics such as fashion, personal appearance, weight loss, exercise, nutrition, and muscle gains. The number of sources they consulted expressed their interest in these topics, they could also select that they didn't use any source of information, meaning that they were not interested in the topic. Then, students were asked to indicate the 3 top Instagram profiles (accounts with more than 10000 followers) they follow daily.

During the two sessions of the workshop, the students were given approximately 20 minutes, each session, for free-roaming on the educational platform, where they had the opportunity to publish their content and interact with the content already published in the platform and by their classmates. Following the data collection, an algorithm was developed that would allocate a role (beauty, fitness, or neutral) to each student based on the footprint they left behind them.

3 Results

3.1 Students' social media use

The self-reported answers show that students are interested in both topics, in total the sum of the sources used by students to get information about fitness was 577 and 549 about beauty (Figure 1). However, only 27 students can be considered to be highly interested in the topics (outside of the third quartile), with a score of 5 information sources or more of the maximum of 15 (Figure 2).

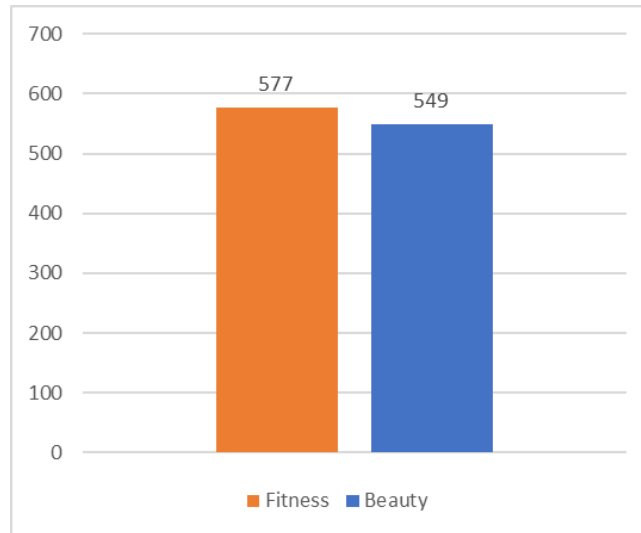


Fig. 1. Total sum of the information sources by each category

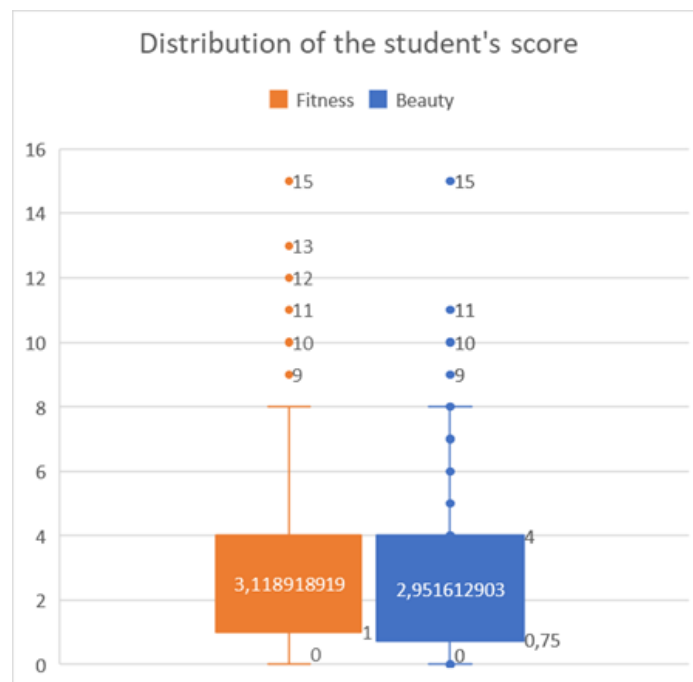


Fig. 2. Distribution of the scores of the information sources by each category

142 students of the 186 total students selected at least one source of information. The distribution of their scores shows different levels of interest in the topics, as can be seen in Figure 3.

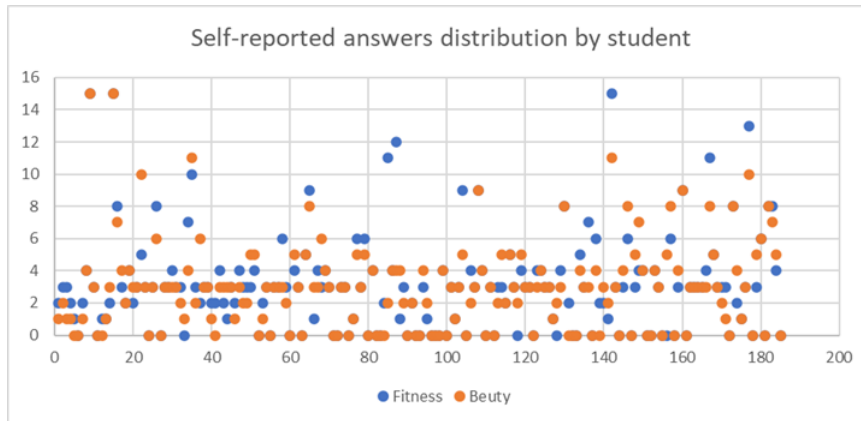


Fig. 3. The distribution of the score from the self-reported questions (Y axis) performed by each of the 184 students (X axis)

3.2 Body Image Content and Influencer preferences

A classification of the category of each influencer was performed manually by research team members. In total, 291 influencers were reported with 181 being unique as some of the most famous influencers were reported more than one time. This classification by categories allowed us to estimate the general narrative of the group showing similar results to the ones of the first approach. However, as it can be seen in Figure 4, students expressed an interest in influencers of the neutral type, that are related to topics like gaming, traveling, or entertainment.

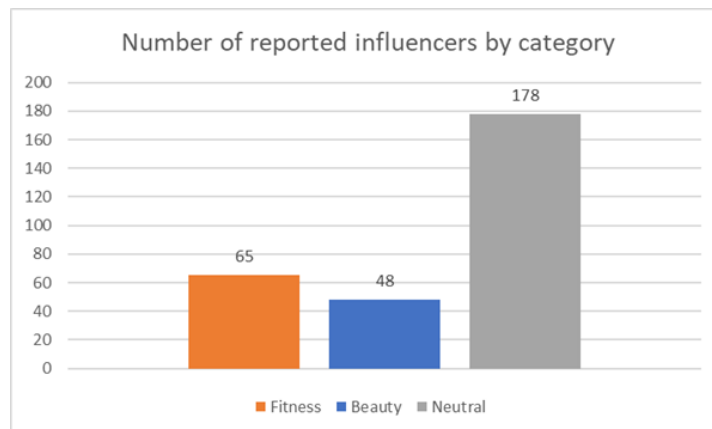


Fig. 4. Number of reported influencers by category

3.3 Students' online behavior

During the study, the xAPI registered 723 interactions created by 102 students. To limit the data collection and analysis to an educational level, only the data related to the predefined profiles were considered. Students viewed photos 99 times, and opened the preloaded profiles 479 times, the predefined influencers were followed 91 times, 15 students left comments, and 43 liked a particular photo. The study of the xAPI data showed that 68.6% of students interacted at least one time with the fitness content related, 35.2% with the beauty, and 46% with the neutral. As shown in Figure 5, the footprint that the students left behind was diverse which could be an indicator that students were interacting with the content following their personal preferences. In Figure 6, the average of the interaction scores for each role shows that the most dominant category is the fitness aligned with the results of the first approach. Although the standard deviation of the answer is high, fitness is equal to 24,4 beauty 5,39 and neutral 12,02 this shows that not all the students had the same amount of influence by a stereotype.

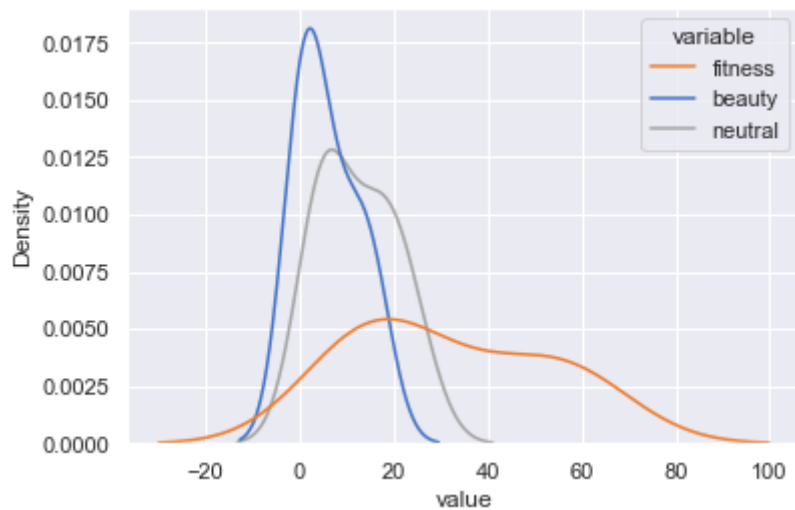


Fig. 5. The distribution of the score (KDE) for the three categories. Score value (X axis), density (Y axis)

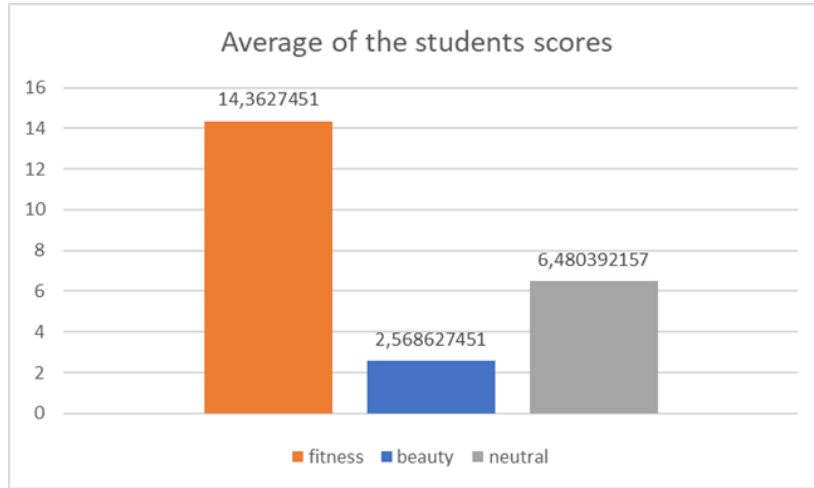


Fig. 6. Average score of the 102 students in the three categories

4 Discussion

The challenge of identifying students' body image stereotypes in an educational platform lies in understanding the user's interests. The two first approaches collected self-reported data from the students at the start of the first session. The first approach asked students to report their preferred source of information for the different types of content. In total, 142 students selected at least one source providing insights into their social media activities. However, this approach had its limitations as not all students selected an answer and there was not an option for neutral profiles. In addition, a few students did not pay much attention to the questions and selected the same answer for all the sources of information.

The second approach prompted the students to indicate the top three Instagram profiles they follow daily. This approach had a different set of limitations primarily on data analysis. Students reported personal profiles that did not reach the threshold of 10000 followers, the profile names were not written correctly, and finally, there was a need to manually identify the profile types during the data analysis, making a future automated analysis difficult. However, the list of influencers can be used as an input for the creation of more realistic predefined profiles in the educational social network.

The third approach of xAPI gathered the most data points as students performed 723 interactions with the predefined content in a varied way. Students interacted with the predefined content naturally as they were not instructed to interact with it, a potential indicator of their real interest. However, only 102 students out of the 184 interacted with the predefined content.

In all three approaches, the narrative of fitness was the most dominant one showing a form of consistency across the different approaches. With each approach having its own sets of strengths and limitations (see Table 1) its selection merely depends on the type of study and system that will be implemented.

Table 1. Strengths and limitations of the three approaches

Approach	Strengths	Limitations
Self-reported questions	- Number of answers, as questions can be marked as mandatory in a questionnaire	- Is not possible to know the validity of the answers and students' levels of attention. - An integration between the survey software and the education platform is needed
Top influencers list	- Can be used to know the general interests of the group - Identify direct dangers hidden behind the profiles that students interact with.	- Difficult to integrate, the classification of the influencers has to be done manually
xAPI	- Unsupervised and more natural interaction with the content - Easily integrated in the educational platform	- Is not guaranteed that the students will interact with the predefined content

However, computer-based detection techniques can be crucial for new learners because information is initially insufficient to build appropriate learner profiles [32]. Some computer-based detection techniques require large amounts of training data to achieve accurate trait identification [33]. Therefore, some researchers use a hybrid technique, which combines two or more techniques (either a mix of both questionnaire and computer-based techniques or a combination of computer-based techniques) [34]. These mix of questionnaires and computer-based trait estimation can be used to adapt the collaborative learning task structure (changing the order of the activities based on the student) or to modify the social structure of future activities (adjusting the group formation).

5 Conclusion

A comparison between two self-reported approaches and the use of xAPI has revealed a set of strengths and limitations for each approach. With the preliminary results showing a similar tendency of dominant stereotype preference amongst the students, the selection of the most appropriate approach depends on the type of study that will be conducted.

The use of xAPI has shown to be an adequate approach for an automated system to track students' behavior. The students successfully interacted with predefined

influencers on a social media educational platform and their interactions matched their self-reported top followed influencer types. Therefore, in a future study, the implementation of adaptive counter-narratives can be achieved by tracking the student's digital footprint using xAPI and a counter-narrative allocation algorithm. The self-reported approach using indirect questions about the studied categories also showed good results and can be used as a complementary way to detect the dominant stereotype for the students that do not interact with the predefined profiles and do not generate xAPI data.

In future studies, we plan to use the xAPI approach to provide an adaptive learning experience with the use of the counter-narratives, by creating an intervention using the Jigsaw CLFP and grouping students based on their dominant category. Also, we plan to extend this work by implementing more types of counter-narratives based on body image perception, body image preoccupation, and dissatisfaction.

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References

1. de Lenne, O., Vandenbosch, L., Eggermont, S., Karsay, K., & Trekels, J. (2020). Picture-perfect lives on social media: a cross-national study on the role of media ideals in adolescent well-being. *Media psychology*, 23(1), 52-78
2. Fardouly, J., & Vartanian, L. R. (2016). Social media and body image concerns: Current research and future directions. *Current opinion in psychology*, 9, 1-5. <https://doi.org/10.1016/j.copsyc.2015.09.005>
3. Ahadzadeh AS, Pahlevan Sharif S, Ong FS (2017) Self-schema and self-discrepancy mediate the influence of Instagram usage on body image satisfaction among youth. *Comput Human Behav* 68:8–16. <https://doi.org/10.1016/J.CHB.2016.11.011>
4. Marengo D, Longobardi C, Fabris MA, Settanni M (2018) Highly-visual social media and internalizing symptoms in adolescence: The mediating role of body image concerns. <https://doi.org/10.1016/j.chb.2018.01.003>
5. Verrastro V, Fontanesi Lilybeth, Liga F, et al (2020) Fear the Instagram: beauty stereotypes, body image and Instagram use in a sample of male and female adolescents. *Qwerty - Open Interdiscip J Technol Cult Educ* 15:31–49. <https://doi.org/10.30557/QW000021>
6. Cash, T. F., & Smolak, L. (Eds.). (2011). *Body image: A handbook of science, practice, and prevention*. Guilford press.
7. Saiphoo, A. N., & Vahedi, Z. (2019). A meta-analytic review of the relationship between social media use and body image disturbance. *Computers in human behavior*, 101, 259-275. <https://doi.org/10.1016/j.chb.2019.07.028>
8. Hou Y, Xiong D, Jiang T et al. (2019) Social media addiction: Its impact, mediation, and intervention. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*. <https://doi.org/10.5817/cp2019-1-4>

9. McLean S, Wertheim E, Masters J, Paxton S (2017) A pilot evaluation of a social media literacy intervention to reduce risk factors for eating disorders. *International Journal of Eating Disorders* 50:847-851. <https://doi.org/10.1002/eat.22708>
10. Sánchez-Reina, J. R., & Fuentes, C. B. (2016). Comunicación De La Salud En La Campaña «Chécate, Mídete, Muévete». *Representaciones y eficacia. Razón y Palabra*, 20(94), 645-662.
11. Hernandez-Leo, D., Theophilou, E., Lobo, R., Sánchez-Reina, R., Ognibene, D., (2021) Narrative scripts embedded in social media towards empowering digital and self-protection skills, *European Conference on Technology-Enhanced Learning*, pp, Springer LNCS.
12. New Media Consortium. (2018). *NMC Horizon Report: 2018 Education Edition*. Retrieved June
13. Hattie, J. (2008). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. London: Routledge
14. Taylor, D. L., Yeung, M., & Basset, A. Z. (2021). Personalized and adaptive learning. In *Innovative Learning Environments in STEM Higher Education* (pp. 17-34). Springer, Cham.
15. Woolf, B. P. (2010). Student modeling. *Studies in Computational Intelligence*, 308, 267–279. https://doi.org/10.1007/978-3-642-14363-2_13
16. Nur Baiti Afini Normadhi, Liyana Shuib, Hairul Nizam Md Nasir, Andrew Bimba, Norisma Idris, Vimala Balakrishnan, Identification of personal traits in adaptive learning environment: Systematic literature review, *Computers & Education*, Volume 130, 2019, Pages 168-190, ISSN 0360-1315, <https://doi.org/10.1016/j.compedu.2018.11.005>.
17. Dillenbourg, P. (2004). Split where interaction should happen-A model for designing CSCL scripts. *Instructional design for effective and enjoyable computer-supported learning*, i-ii.
18. Jermann, P., & Dillenbourg, P. (2003). Elaborating new arguments through a CSCL script. In *Arguing to learn* (pp. 205-226). Springer, Dordrecht.
19. Amarasinghe, I., Hernández-Leo, D., & Jonsson, A. (2019). Data-informed design parameters for adaptive collaborative scripting in across-spaces learning situations. *User Modeling and User-Adapted Interaction*, 29(4), 869-892.
20. H. Fasihuddin, G. Skinner and R. Athauda, "Towards an adaptive model to personalise open learning environments using learning styles," *Proceedings of International Conference on Information, Communication Technology and System (ICTS) 2014*, 2014, pp. 183-188, doi: 10.1109/ICTS.2014.7010580.
21. Sinem Aslan, Eda Okur, Nese Alyuz, Sinem Emine Mete, Ece Oktay, Utku Genc, and Asli Arslan Esme. 2017. Students' emotional self-labels for personalized models. In *Proceedings of the Seventh International Learning Analytics & Knowledge Conference (LAK '17)*. Association for Computing Machinery, New York, NY, USA, 550–551. <https://doi.org/10.1145/3027385.3029452>
22. A. Hidayat and V. G. Utomo, "Automatic detection of learning style in adaptive online module system," *2016 International Conference on Informatics and Computing (ICIC)*, 2016, pp. 94-98, doi: 10.1109/IAC.2016.7905696.
23. Verrastro, V., Fontanesi, L., Liga, F., Cuzzocrea, F., & Gugliandolo, M. C. (2020). Fear the Instagram: Beauty stereotypes, body image and Instagram use in a sample of male and female adolescents. *Qwerty*, 15(1), 31–49. <https://doi.org/10.30557/QW000021>
24. Niemann YF, Jennings L, Rozelle RM, Baxter JC, Sullivan E. Use of Free Responses and Cluster Analysis to Determine Stereotypes of Eight Groups. *Personality and Social Psychology Bulletin*. 1994;20(4):379-390. doi:10.1177/0146167294204005
25. Butkowski, C. P., Dixon, T. L., Weeks, K. R., & Smith, M. A. (2020). Quantifying the feminine self(ie): Gender display and social media feedback in young women's Instagram

- selfies. *New Media and Society*, 22(5), 817–837. <https://doi.org/10.1177/1461444819871669>
26. Kitto, K., Cross, S., Waters, Z., & Lupton, M. (2015). Learning analytics beyond the LMS. 11–15. <https://doi.org/10.1145/2723576.2723627>
 27. A. Cooper, “Learning analytics interoperability-the big picture in brief,” *Learn. Anal. Community Exchange*, pp. 1–7, 2014.
 28. De Croon, R., Wildemeersch, D., Wille, J., Verbert, K., & Vanden Abeele, V. (2018). Gamification and serious games in a healthcare informatics context. *Proceedings - 2018 IEEE International Conference on Healthcare Informatics, ICHI 2018, August*, 53–63. <https://doi.org/10.1109/ICHI.2018.00014>
 29. Wang, Y., & Wang, M. (2021). Data acquisition model for online learning activity in distance English teaching based on xAPI. *International Journal of Continuing Engineering Education and Life Long Learning*, 31(1), 1-16.
 30. Manso-Vazquez, M., Caeiro-Rodriguez, M., & Llamas-Nistal, M. (2018). An xAPI Application Profile to Monitor Self-Regulated Learning Strategies. *IEEE Access*, 6, 42467–42481. <https://doi.org/10.1109/ACCESS.2018.2860519>
 31. Davies G, Ouellet M, Bouchard M: Toward a Framework Understanding of Online Programs for Countering Violent Extremism. *J Deradicalization Spring*, 51–86 (2016)
 32. Baldiris, S., Graf, S., & Fabregat, R. (2011, July). Dynamic user modeling and adaptation based on learning styles for supporting semi-automatic generation of IMS learning design. In *Advanced Learning Technologies, IEEE International Conference on* (pp. 218-220). IEEE Computer Society
 33. Lukassenko, R., & Grundspenkis, J. (2010). Adaptation of intelligent knowledge assessment system based on learner’s model. In *Proceeding on the 16th International Conference on Information and Software Technologies, Kaunas, Lithuania..*
 34. Normadhi, N. B. A., Shuib, L., Nasir, H. N. M., Bimba, A., Idris, N., & Balakrishnan, V. (2019). Identification of personal traits in adaptive learning environment: Systematic literature review. *Computers & Education*, 130, 168-190.