SCIENCE ON YOUTUBE: SUCCESSFUL EDUTUBERS

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KEYWORDS	ABSTRACT
	The growing use of video as an educational resource and of the YouTube platform in our society leads us to investigate the impact of educational YouTube Science channels and the success factors and variables used by edutubers in this area. Through the analysis of the 41 most successful educational channels of Sciences on YouTube Spain, we obtain results on different aspects of the process of creation and dissemination of audiovisual content. The conclusions indicate a high impact of the YouTube channels of Sciences and a positive trend, anticipating a great projection of edutubers and educational audiovisual content in this area of knowledge. In addition, the success factors and variables used by edutubers in their channels are pointed out. Our research provides insights for teacher training plans and YouTube educational content creators.

1. Introduction

Science as an area of knowledge has been transmitted from generation to generation throughout the History of mankind using a great diversity of methodologies, supports, and materials depending on the advances that were produced in societies. One of the great leaps in this area occurred with the introduction of technology and the expansion of internet use among the population. Regarding the use of web pages over the internet, YouTube stands out as a storage platform for digital audiovisual resources.

The large number of subscriptions to YouTube channels and the large number of views of these audiovisual resources at an international level demonstrate the impact of this type of implementation in our current society. Therefore, it is important to analyse how this impact is being produced in the area of education (Rangarajan et al., 2019) either in a formal (Sarkar et al., 2019; Walsh et al., 2019) or informal way (Rosenthal, 2018).

The literature shows us that this platform is chosen by educators as a preferred learning tool (Srinivasacharlu, 2020), pointing to it as an opportunity for innovation (Anchundia, 2020) and using it within class implementations, or as complements to this (Tella et al., 2020), having a positive assessment of its use by teachers (García-Martín & Cantón-Mayo). In addition, it is possible to verify frequent use of YouTube videos by teachers to obtain academic purposes (Anchundia, 2020) or to improve students' desire to learn (Ozudogru, 2020), even those belonging to social minorities or low-income places (Peppler et al., 2020).

On the other hand, students prefer, among all the possibilities of social networks for the educational field, audiovisual resources (Torun, 2020), where YouTube stands out as the main platform (García-Jiménez et al., 2020), they value positively the use of YouTube videos in the masterclasses (Díaz et al., 2020) and have a great intention in the use of this page in an educational way (Maziriri et al., 2020) due to its flexible, interesting and informal attractive proposal (Wang & Chen, 2020). There are also benefits in the technological, educational, and social dimensions of students when they assume, in a didactic way, the role of a YouTuber as a learning method (Chen,

2020). However, it is important to highlight that for YouTube educational success and positive impact on learning, students' motivation to learn must be enhanced, as well as their ability to control and manage digital resources, and their ability to search and evaluate information (Halpern et al., 2020), as well as those of selection and reliability (Maraza-Quispe et al., 2020), so that there is a true academic achievement through the use of the platform. Otherwise, academic performance may even be lower with the uncontrolled use of videos (Halpern et al., 2020).

Therefore, the evidence is highlighted on the benefits and drawbacks of the use of YouTube in education (Macias-Silva et al., 2020). On the one hand, its implementation enhances an improvement in academic performance (Arevalo et al., 2020; Veytia Bucheli et al., 2020), student motivation (Fenyvesi, 2020; Yildrim, 2018), satisfaction with their learning (Del Valle-Ramón et al., 2020) and the acquisition of competencies (Ortega, 2020; Paladines-Paredes & Margallo, 2020) or values (Villacampa Morales et al., 2020). On the other hand, the use of YouTube videos in education can also promote inattention on the part of students (Zureick et al., 2018), the loss of control of the classroom climate while viewing the videos (Behesti et al., 2018), the lack of scientific rigor (Beltrán-Pellicer et al., 2018) or the loss of the objectives and the focus of the study (Esparza Purga, 2018).

In the area of Sciences (Physics, Chemistry, and Biology), the literature shows us that the educational use of YouTube videos promotes the achievement of subject objectives and academic performance (Bohloko et al., 2019; Leonard, 2020; Rose et al., 2019) either from a conceptual (Jena et al., 2020) or procedural (Koto, 2020; Rodgers et al., 2020) perspective. In addition, students in this area positively evaluate its use (Marçal et al., 2020) as an innovative methodology (Abbott et al., 2019) and view the videos as support for their training regardless of the intellectual capital of their parents (Rüschenpöhler & Markic, 2020), in a frequent way (Pickering & Swinnerton, 2019) enhanced by the informal possibilities of its implementation (Rosenthal, 2018).

Among the research on YouTube educational channels, it is worth highlighting the contribution on the success and impact factors of these channels (Pattier, 2020), the analysis of the statistical

variables inherent to the YouTube platform (López et al., 2020; Saurabh & Gautam, 2019), the mathematical video evaluation instrument (Romero-Tena et al, 2017) and the rubrics for the analysis of the quality of children's audiovisual resources on the YouTube platform (Neumann & Herodotou, 2020). In the area of Sciences, the proposals for the creation of videos to prepare students for laboratory practices stand out (Rodgers et al., 2020); the dialogue approach and the explanation of misconceptions as success factors of the videos (Margoniner et al., 2019); and the appreciation of rigor, credibility, and reliability by YouTubers (Vizcaíno-Verdú et al., 2020).

Moreover, the objective of our research is to analyse YouTube channels in the Science area in order to solve the following research questions: What is the impact of educational Science YouTube channels in our society today? What factors stand out in these channels as variables of success taking into account the process of creating and publishing the videos?

2. Methodology

2.1 Instrument

Thanks to the previously provided literature, an instrument was designed to analyse YouTube educational channels and obtain relevant data on our research topic. The dimensions and items of the instrument are shown in Table 1.

Table 1. Dimensions and items of analysis instrument

Dimensions	Items
Data and statistics	Number of subscribers
	Number of views
	Channel creation date
	Date of upload of the first video to the channel
	Total number of videos
	Average upload of videos to the channel
	Average length of videos
Structuring the videos	Typology of videos
	Language
	Use of engagement
	Presentation of the objective of the video
	Relationship between the channel's videos
	Use of final synthesis in videos
	Curriculum structuring of the videos
Recording and editing the videos	Type of plane used
	Type of angle used
	Number of people appearing
	Image or video overlay
	Dynamic editing effects
Edutuber personality	Physical appearance of the YouTuber
	Type of language used
	Use of swear words
	Use of humorous aspects
	Characteristic name for the audience
	Channel nomenclature
	Costume
Use of the YouTube platform	Number of edutubers on the same channel
	Home panel
	Channel header
	Option to comment on videos
	Playlists
	Community function
	Links to other channels
	Store function
	Option of patronage or donation
Use of social networks	Twitter
	Instagram
	Facebook

Source: Own elaboration

2.2 Validation and reliability

The instrument was validated by experts related to the world of education, research, and communication. In this way, all the experience of teachers, researchers, and YouTube content creators was used to develop an instrument that would make possible the achievement of our objectives.

On the other hand, the instrument demonstrated high reliability and consistency indicated by Aiken's V coefficient for content validity in each of the final items that made up the instrument. In addition, a positive evaluation of the reliability of the instrument's scale was obtained through Cronbach's Alpha ($\alpha = .83$).

Finally, the instrument was tested with a series of educational YouTube channels in a pilot way, corroborating that the instrument collected the data necessary for our research optimally and reliably.

2.3 Sample

For the selection of the sample, the educational YouTube channels were delimited taking into account the following parameters as shown in table 2.

Table 2. Parameters for the delimitation of the sample

Parameter	Developing
Country	Only educational YouTube channels from Spain were taken into account.
Number of subscribers	YouTube channels with a minimum of 1,000 subscribers were chosen (YouTube Opal level).
Number of views	YouTube channels with a minimum of 300,000 total views were chosen.
Knowledge area	The analysis of educational YouTube channels that were clearly identified with the area of Sciences (Physics, Chemistry, and Biology) was arranged.
Ownership	The channels of individuals (edutubers) and not directed by associations or institutions were taken into account.

Source: Own elaboration

Through the application of these parameters to YouTube educational channels, a total sample of 41 channels was obtained, which we can consider as the ones with the most impact and success on YouTube taking into account the previously exposed delimitations.

The sample is characterized by belonging 80.5% to male edutubers and 19.5% to women. In addition, YouTube channels are focused on Secondary and Baccalaureate (41.5%), University (9.7%), or do not have a specific educational stage defined (48.8%), while there is no channel, that exceeds the parameters taken in our research and that they focus their videos on an audience of the Infant, Primary or Professional Training stage.

2.4 Data analysis

The analysis of the extracted data was carried out using the SPSS 25.0 program both in descriptive statistics and in the analysis of contingency tables.

3. Results

3.1 Data and statistics

Science YouTube educational channels have a number of subscribers between the following ranges: 1,000 - 10,000 (31.7%), 10,000 - 100,000 (26.8%), 100,000 - 1 million (29.3%), more than 1 million (12.2%). Statistically significant differences ($p < .05$) are found in comparison with other areas of knowledge in the two highest ranges indicated, appreciating a greater number of subscribers. Regarding the number of total views of the channels, we found the following results: 300,000 - 1 million (24.4%), 1 million - 5 million (34.1%), 5 million - 10 million (7.3%), 10 million - 50 million (19.5%), more than 50 million (14.6%).

On the other hand, the data obtained regarding the creation date of the channels and the start date of uploading the videos to the channel are shown in table 3:

Table 3. Comparison between the channel creation date and the upload date of the videos to the YouTube educational channel

	2005-2010	2011-2015	2016-2020
Channel creation date	12.2%	56.1%	31.7%
Start date of uploading the videos to the channel	4.9%	41.4%	53.7%

Source: Own elaboration

The total number of videos hosted by the educational YouTube channels on Science are among the following ranges: 11 - 50 (9.8%), 51 - 100 (19.5%), 101 - 1,000 (70.7%), while there are no channels, within the established parameters, that present between 1 and 10 videos, or more than 1,000 videos. The average upload of videos to the Science channels is as follows: at least once a week (34.1%), once every two weeks (43.9%), once a month (12.2%), every two months (7.3%), every more than two months (5.4%). There are significant differences (p = .014) that show a decrease in Science channels that their average video upload is once a month and an increase in the number of channels that show an average upload of videos every two weeks.

The results on the average duration of the channel's videos are as follows: less than 5 minutes (22%), between 5 and 10 minutes (41.4%), between 10 and 30 minutes (36.6%), while there is no channel of our sample with an average duration in their videos of more than 30 minutes. There are statistically significant differences (p = .003) that indicate a decrease in the number of Science channels whose average duration of the videos is less than 5 minutes.

3.2 Structuring the videos

The typology of the videos of the channels analysed response to the following classification: explanatory (82.9%), examples or experiences (14.6%), and songs (2.4%). Significant differences are shown (p <.001) that indicate less use of tutorial-type videos (in the case of the Science area, there is no channel, that uses it) and greater use of explanatory videos compared to channels of other areas of knowledge.

Regarding the language in which the videos are usually uploaded to the channels, we found that 39 of the 41 channels analysed usually upload the videos in Spanish, while 1 channel did so in Basque and another channel in Galician.

On the other hand, Science edutubers, when structuring the videos on their channel, tend to use engagement as a way to capture the attention of users significantly more than channels from other areas (22%), they usually present the objective of the video (80%), they relate significantly more the videos that are uploaded to their channel (24.4%), they do not use the summary or final synthesis in the videos, and they do not usually structure the videos depending on the academic curriculum (92.7%).

3.3 Recording and editing the videos

YouTube content creators in our study area use the following types of shots when recording their videos: medium (63.4%), close-up (22%), and no shot (14.6%). We found significant differences (p = .003) that show greater use of the midplane in the videos of the Science area. Regarding the type of angle used by the edutubers, we found the following results: normal (78%), zenith (7.3%), upshot (2.4%), down shot (2.4%), or they did not use angles (9.8%). There are statistically significant differences (p = .033) that indicate greater use of the normal angle in the educational YouTube channels of Sciences.

Regarding the number of people who appear in the videos, we find that in 38 channels only one person appears in the videos, while in 3 channels, 2 people usually appear in the audiovisual resources shared on the channel. It can be seen that, compared to educational channels in other areas, there is an increase in the presence of more than one person in the videos.

In editing the videos in our sample, the results show that 75.6% of the Science channels only use one image or video at the same time in their resources, and do not combine them with others at the same time. Furthermore, 70.7% of the channels do not use dynamic video editing effects either.

3.4 Edutuber personality

The results show that Science edutubers decide to appear, significantly more (p = .022) in their

videos physically (75.6%) than content creators from other areas. In addition, they use a normal type of language (65.9%), youthful (17.1%), academic (14.6%), or the language is not used (2.4%). No Science channel was found that used children's language in its audiovisual content. There is a significant difference (p <.001) in this aspect, which indicates that Science edutubers use a more academic language and, above all, more youthful, than the other areas of knowledge.

On the other hand, the channels in our sample do not use swear words or bad language in their videos. In addition, 34.1% of Science edutubers use humorous elements within their resources, verifying an increase, although not significant, in the use of this type of element among audiovisual content creators in the Science area.

The use of a characteristic name to address the audience is used by 19.5% of channels, while 73.2% of Science EduTubers choose an impersonal nomenclature as the name of their channel, with a higher trend than EduTubers from other areas of knowledge. Finally, 2 YouTubers from the analysed sample use a characteristic costume or outfit in their videos.

3.5 Use of the YouTube platform

40 of the 41 channels analysed are run by just one edutuber. The remaining channel is run by two edutubers. Within the home panel, YouTubers choose the following possibilities offered by the YouTube platform: show the last video uploaded to the channel (34.1%), offer a video presentation of the channel (34.1%), expose a popular video of the channel (26.8 %), offer a specific playlist (2.4%) and show a video of appreciation to the audience for obtaining a significant number of subscribers on the channel (2.4%).

On the other hand, 37 of the channels analysed use the channel header to link users to other pages or their social networks, showing a higher trend in its use than other areas of knowledge. In addition, 39 channels have the option to comment on their videos active, with significantly higher data (p = .022) than other channels. In addition, 38 channels in the sample offer playlists created by edutubers for the audience.

The Community function is used by edutubers occasionally (46.4%), recurrently (26.8%) or they do not use it (26.8). In this section, we find

statistically significant differences (p = .001) that indicate that the Science channels use this function to a greater extent than the channels of other areas of knowledge. Similarly, 75.6% of Science edutubers link to other YouTube channels, with a significantly higher trend than their counterparts in other areas.

Finally, there is a channel among the entire sample that uses the Store function for the sale of articles related to the channel, while 6 Science channels offer users the possibility of patronage or donation to the channel.

3.6 Use of social networks

The results of our research show a greater trend to use social networks by Science edutubers than in other areas of study. 85.4% of the channels analyzed are also present on Twitter, 68.3% on Instagram, and 78% on Facebook. A statistically significant difference (p = .047) stands out in the greater use of Twitter by Science YouTubers.

4. Discussion and conclusions

Thanks to the analysis of the results obtained, we can answer our two research questions. Firstly, our objective was to know the impact of the educational YouTube channels of Sciences in our current society. In this regard, it stands out that 8 out of 10 edutubers in this area are men, which shows an accentuated gender gap among YouTube content creators in the Science area, as pointed out by other research focused on YouTubers (Regueira et al., 2020) or in education professionals (Mistry & Sood, 2016). On the other hand, if we take into account that the impact can be measured through the statistical data offered by the channels (Saurabh & Gautam, 2019), we must delve into the analysis of the number of subscribers and total views of the channel. Therefore, we can observe a significantly high trend for Science channels to get more subscribers than in other areas. This is due, in part, to the fact that they usually deal with topics of interest to the public (Vizcaíno-Verdú et al., 2020) that manage to attract a greater number of followers. In addition, we find that the data on the number of views that reach these types of channels is quite high. Moreover, we can conclude that the impact of the

educational YouTube channels on Sciences is currently high, managing to provide a necessary education in topics of this area in the whole of society (Acosta, 2016).

On the other hand, it is important to know the trend of this impact to determine if it is positive or negative. To do this, we analyse the comparison between the creation date of the channel, that is, when a person opens the channel to be able to comment or interact with videos on the YouTube platform, and the date on which this person begins to upload videos to their channel becoming an edutuber. As table 3 shows, in the last range of years (2016-2020) there is a proliferation of people who decide to start uploading videos to channels that they had previously created, and the number of people who create their own channel and publish their first videos. In this way, if the current trend is followed, the impact of the educational YouTube channels of Sciences will increase in the coming years due to the increasing number of channels in this area, the positive reception within the educational processes (Wei & Chou, 2020) and the high satisfaction in its use by education professionals (García-Martín & Cantón-Mayo, 2019; Srinivasacharlu, 2020), students (García-Jiménez et al., 2020; Marçal et al., 2020) and the general audience.

Secondly, our next research question leads us to the analysis of the success factors and variables of the channels studied, taking into account the process of creating and publishing the videos. Through the analysis of the data obtained thanks to our instrument, we can highlight the following factors and conclusions:

Science channels are quite prolific, as we can see in the results that show that 78% of them upload videos 1 time a week or 2 times a week, but they do not have a number too high of content on their channels (no channel exceeded 1,000 videos). This shows that edutubers probably dedicate time to content quality (Vizcaíno-Verdú et al., 2020), in contrast with research on the subject that indicates a greater dedication to the quantity than to the quality of the videos (Neumann & Herodotou, 2020).

On the other hand, Science content creators tend to create fewer videos than their counterparts in other areas with a duration of less than 5 minutes and showing a preference for uploading videos of a duration between 5 and 10 minutes, and between 10 and 30 minutes, which together group 78% of the channels analysed. We can conclude that, therefore, Science edutubers need to dedicate more time to the exposure of their contents due to the characteristics of the area in which they work, which shows disparity with global research among students that indicate a preference for shorter videos (Long et al., 2016). Moreover, we can observe a preference on the part of the audience within this area of knowledge for videos with a higher average duration than other areas, comparing other investigations in this regard (Alpert & Hodkinson, 2019).

In addition, Science edutubers are characterized by the use of a clear explanatory video typology where 8 out of 10 channels use it. There is evidence of a trend in the area of Sciences, in the world of YouTube, to be configured by a series of edutubers who explain topics related to their area, as other research points out in this regard (Margoniner et al., 2019). It should be noted that the examples or experiences, so widely used in this educational area of knowledge, do not reach 15% of use in educational YouTube channels. We conclude that the typology of examples and experiences is not as successful on the YouTube platform and that what users usually look for is an explanation of a specific topic in the area of Sciences.

On the other hand, the language used in YouTube channels directly affects the internationalization of resources and enhances the impact worldwide (Pattier, 2020). Moreover, the vast majority of Spanish Science channels opt for Spanish as the channel's vehicular language, which allows wide dissemination not only in Spain but also in Latin America. Even so, two channels stand out that use languages with a reduced number of speakers compared to Spanish, but which have also established themselves as successful educational channels, exceeding the parameters established for the selection of the sample. In this way, two channels that use Galician and Basque, spoken only in specific regions of northern Spain (Galicia and the Basque Country respectively), also manage to position themselves as references among Spanish

Science videos. Although Spanish is a language of international diffusion and with great global impact, support for educational channels that use languages from more specific and smaller regions should be promoted by associations and institutions as a means to promote the impact and diffusion of the language itself within its region and, why not, internationally.

Taking into account the structure of the videos of the channels studied, and although there is a greater trend towards the use of engagement (Saurabh & Gautam, 2019) or a greater relation on videos within the same channel, we can affirm that the great factor of success within this theme is the presentation of the objective of the video (López et al., 2020; Rodgers et al., 2020), which is used by 8 out of 10 successful Science channels. However, we find as non-significant variables in the success of the edutubers the use of engagement, the relationship between the videos of the channel itself, the use of the summary or synthesis at the end of the videos, and the structuring of the resources depending on the academic curriculum.

Regarding the recording of the videos, we can observe a trend of successful Science edutubers to use the median plane and the normal angle, corroborating other research on the subject (Quintero-Ramírez, 2017). This type of shot and recording angle allows the edutuber to be viewed in an optimal way for the explanatory video typology, which, as we have pointed out previously, is preferred by the content creators of this area, and shows an attention to the edutuber image (López-Aguilar, 2018). On the other hand, there is also a predisposition for the appearance of a single edutuber in the videos. In this way, we can show that the collaborations between edutubers in this area are made in specific videos and not in a regular way within YouTube channels.

Regarding the editing of audiovisual resources, the results show that, on the one hand, the superposition of images or videos at the same time, and, on the other hand, the editing of the video with dynamic effects, are not factors of success on the Science YouTube channels. We can observe a link between the limited edition of the videos and the number of videos uploaded to the channels and their

duration. Moreover, when uploading videos regularly, with an average duration, we observe that Science edutubers do not spend a lot of time editing their videos, but rather they usually present themselves talking about a particular topic, using the process of editing to cut and join the recording shorts in a single file and resource to upload it to the YouTube platform.

The personality of the edutuber is reflected in certain aspects and variables that we can find in the channels and the videos created by them. Thanks to the analysis of the data from our research, we can conclude that Science YouTubers have a higher tendency than their counterparts from other areas to appear physically in videos. This generates in the audience a feeling of closeness with a person who is speaking to them from the other side of the screen, even if it is an asynchronous audiovisual resource. On the other hand, it makes the video editing process easier and can thus facilitate the trend of creative proliferation of audiovisual resources by Science edutubers. On the other hand, it is noteworthy that YouTubers in this area widely choose a standardized language for their videos, corroborating other research on the subject (Long et al., 2016; Rodgers et al., 2020), and that there is a significantly high difference with the rest of the areas indicating that they use a more youthful language to a greater extent. We can conclude, therefore, that Science edutubers tend to address a very open audience, with an accessible language, and with a trend towards a youth audience (Vizcaíno-Verdú et al., 2020).

This more youthful and normalized trend on the part of the Science edutubers does not transcend the use of swear words or bad language in what we could call an extreme discourse of social networks (Pereiro & Campos, 2020), but rather they are established within a normalized and adequate range of language. In addition, we can conclude that YouTubers in this area tend to be more comical than content creators in other areas. This also demonstrates the more youthful and laid-back approach of Science edutubers.

The personality of the edutuber and the presentation of the channel to the audience, pass, first of all, by the choice of the name of the

YouTube channel. It stands out that practically 3 out of 4 creators of educational content in Sciences on YouTube use an impersonal nomenclature of their channel. This shows an attempt by edutubers to create a space, an atmosphere, a new construct on YouTube, with an aim of differentiating themselves (Pattier, 2020) from their real names or surnames to build a world created by the YouTuber that can attract attention or interest the audience.

On the other hand, there are numerous ways to use the YouTube platform due to the possibilities it offers to content creators through its educational channels. Knowing the success factors and variables of the Science channels will allow us to understand the process that edutubers in this area are following when it comes to choosing the possibilities of their channel. Therefore, it stands out that practically all the Science channels are directed by only one edutuber. This, together with the high average upload of videos to their channels, shows that the Science edutubers are very involved in the creation of audiovisual content on YouTube and that they dedicate much of their time to it.

The home panel is very important on YouTube channels as it usually offers the first impression of the channel's content to the potential audience. In such an immediate society in which we live, this home panel is very important since it can determine, in a matter of seconds, if the person who has arrived there, decides to start browsing between the videos of the channel, or simply change between channel by not being attracted to the content offered on it. Our research data shows that Science edutubers do not have a specific preference in choosing the possibilities offered by the platform to display the channel from the home panel. Moreover, we find three possibilities that are the most used by YouTubers in this area of knowledge: showing the last video uploaded to the channel, offering a presentation video of the channel, or exposing a popular video of the channel. We conclude, therefore, that the choice of one of these three possibilities for the home panel can be a success variable in the educational impact of YouTube channels.

On the other hand, 9 out of 10 Science channels use the channel's header to offer links to users with other pages or with the edutuber's social networks. This indicates a trend for edutubers to pretend that the audience not only connects with them through the YouTube platform but also through other types of platforms or networks. We conclude, therefore, that YouTubers not only try to create a world on the YouTube platform but also a space that transcends the platform itself (Pattier, 2020). This world is connected to users through the option to comment on videos (Xiao, 2017), which the vast majority of educational channels in Sciences have activated. In this way, users can connect and transmit personal views to the channel's videos in a simple and public way. This connection with the audience is significantly greater in the Science channels than in the channels of other areas, which shows a trend of success for these channels to use all the possibilities that YouTube offers to connect with the audience, such as the activation of comments or the use of the Community function, and other social networks and platforms.

In addition, it is evidenced that Science edutubers favour the use of playlists of the topics they address in their channels, which allows the audience to find and view videos by topic in a simple way. On the other hand, the results show that Science channels offer significantly a greater connection between edutubers, offering a greater possibility of linking with other channels on the YouTube platform. This indicates a mutual help on the part of the Science edutubers who offer the possibility that the audience can also meet other content creators on the topics they develop in their channels. We conclude that, currently, Science edutubers are consolidating a special partnership between channels in this area.

Finally, YouTube allows the possibility for content creators to use the Store function to sell items to the audience, or the option of patronage and donations to the channel through platforms such as Patreon and PayPal. It is evident that Science edutubers do not create their content to obtain remuneration through these possibilities of the YouTube platform. In this way, they would only use the basic monetization that depends, largely, on the views of the videos of their channels. Therefore, we conclude that there is altruism in the creation of audiovisual content by

Science edutubers since there is no clear intention to profit from uploading their videos, but rather a disseminating spirit that permeates the entire process of creation and uploading of resources to their YouTube channels. Even so, and following research on the subject (Wilson & Wu, 2020), we conclude that financial support to this type of educational channels would be important so that the positive trend in the creation of audiovisual resources is consolidated.

Regarding the use of other social networks by Science edutubers, as we have already pointed out above, there is evidence of a trend towards the creation of a world and connectivity with users that transcends the YouTube platform. Moreover, the great use by content creators of this area of other social networks such as Twitter, Instagram, or Facebook, indicated as conducive to obtaining academic benefits stands out (Closson & Bond, 2019). The characteristics of each social network offer possibilities that Science edutubers do not miss for interaction with the audience. It is important to note that there is a trend for Science education content creators to use Twitter as the social network of choice after YouTube. Twitter is a space and platform used by numerous institutions, associations, and scientists around the world, and, therefore, it is one of the ideal places to be able to disseminate or comment on Science. For this reason, Science YouTubers use this social network largely, even with the limitations offered by this platform for advertising their videos. We conclude that Science edutubers tend to be part of a global debate (Robles et al., 2020) around the themes of the area that takes place in spaces as different from YouTube as the Twitter platform.

For all this, we can offer the following summary of the success factors and variables of YouTube Science channels in relation to the creation and dissemination of their videos, as we can see in table 4:

Table 4. Success factors of educational YouTube channels on Science

Dimensions	Success factors
Data and statistics	Video upload at least once every two weeks. Average duration of the videos (between 5 and 30 minutes).
Structuring the videos	Explanatory typology of the videos. Use of an international language. Presentation of the objective of the video.
Recording and editing the videos	Use of the median plane and normal angle. Appearance of a person in the videos. Little editing of the videos.
Edutuber personality	Physical appearance of the edutuber in the videos Normalized and youthful language Impersonal YouTube channel nomenclature
Use of the YouTube platform	Channel management by a single edutuber. Appearance in the home panel of the last video uploaded to the channel, presentation video of the channel, or popular video of the channel. Use of the channel header to offer links to users. Activation of the option to comment on videos. Offering playlists on themes. Using the Community function. Offering links to other YouTube channels.
Use of social networks	Presence in other social networks with the following order of preference: Twitter, Facebook, and Instagram.

Source: Own elaboration

In conclusion, this article manages to answer the research questions initially indicated, highlighting that YouTube's educational channels of Sciences have a high impact on education and current society and that this trend is positive and can foresee a high projection of this group and his audiovisual creations in the coming years. Additionally, our study highlights the variables and success factors used by Science content

creators on YouTube. Therefore, the data offered by our research can serve as a basis for the transformation of teacher training plans, adapting them to an educational reality in which the creation of audiovisual content is highly demanded by the new generation of students and by educational situations that demand these types of resources, such as that experienced during the COVID-19 pandemic (Encinas-Martín, 2020). They can also help educational content creators in Science, or in other areas of education, to achieve greater efficiency in their videos and enhance the success and impact of their channels in our society.

As a prospective of this work, we point out the possibility of analysing the YouTube channels of Sciences at an international level, being able to compare the results with those obtained in our research. In addition, it will be important to verify, once the COVID-19 pandemic is over, the possible changes in trends or analyse the impact of this situation on YouTube educational channels as part of the formal and informal education of our society.

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