1. INTRODUCTION

1.1 What is Sustainable Design?

Also called eco design, sustainable design is design that seeks to incorporate responsibility for the ecological, economic and socio-cultural systems that support life. This definition can be applied through several levels of sustainable innovation: incremental, re-design, functional and systematic [7]. The design community reacted to global environmental concerns in the 1970’s, with examples like Viktor Papanek and his book *Design for the Real World: Human Ecology and Social Change* [28]. Nevertheless, it was not until the publication of McDonough and Braungart’s *Cradle to Cradle: Remaking the way we make things* [24], that sustainable design had its first massive diffusion. Although this type of design has been promoted for over a decade, its integration in education and professional practice has mixed levels of acceptance [18, 39].

1.2 Literature Review

Ji and Amor [18] provide evidence that habits of sustainable design students tend to change more than those of professionals. Ueda [41] found that the main driver for Japanese industrial designers in eco-innovation was a technological approach through short-term strategies, and that companies and designers did not show interest in sustainable design education. Also, Niedderer et al. [27] found that the greatest obstacles for eco-friendly behavioral change in the design process are lack of time and evidence of effectiveness. However, most of environmental psychology related research has been conducted through self-reports in developed countries.

More attention should be paid to the role of contextual factors in behavioral changes. Context can be defined as information which helps to characterize the situation of a design object. Zimmermann et al. [45] distinguish five context categories: individuality, time, location, activity and relations. The natural environment can be understood as part of the location category, as part of the individual environment and as part of relations in the case of nonhuman living beings. All the factors can be influenced by the value assigned to the environment and the frequency of contact with it.

Regarding affective aspects, Kuwako defines kansei (perception) as “an ability of sympathy between the environmental world and the self body” [15]. Through kansei words, users are guided to express their affective needs, feelings, emotional states and moods, which in turn can be applied to design more holistic products and services. Bouchard et al. [6] compiled 147 references to link UX design, eco design and kansei; finding that the literature covered design methodologies and software, eco-feedback, behavioural steering, persuasive technologies, user modelling techniques, ergonomics, methodologies to measure subjective emotions, eco-user profiling and scenario analysis (similar to contextual factors). Much of this work has remained on a theoretical level, and the intersection with the study of feelings for the natural environment operating in the development of products and services is still largely ignored.
Moreover, the role of academia in the diffusion of sustainability is not entirely clear. University rankings are calculated according to teaching, research, international output, perceived reputation and other factors, but not sustainability. The University of Indonesia (UI) proposed to integrate infrastructure, energy and climate change, waste management, water management, transportation and sustainability education to create the UI Green Metric World University Ranking on Sustainability. If the 407 participant universities are ranked in terms of sustainability education, the US is the top country, followed by Thailand, Spain and UK [17]. There are centers of sustainable design in top universities around the world as well, and mobility programs enable some students to have contact with other cultures. However, data on sustainable design regarding other countries (especially developing countries) is less specific.

Development of the web also affected education at the university level. Video Networking Sites (VNS) are integrated platforms to upload, manage, share and watch videos, which have been widely successful in relationship with education [19, 31]. Moreover, Moran et al. [26] found that the rate of Social Networking Sites adoption by university faculty was over 90%, being Facebook and YouTube the most cited. According to Cheng et al. [8], YouTube videos have strong correlations between each other, forming small-world networks; tend to last 10 minutes; and rating (liking) and comments have been increasing over time.

Previous research on influence, behavior, decision-making and social networks has shown that those who are perceived to be in the same group wield more influence on attitudes, norms, behavior and decisions than outsiders [9, 25]. In network theory, this concept corresponds to small-world networks, which reflect particular perceptions or kansei [30]. This implies that communities formed around specific topics can be detected and studied through YouTube.

1.3 Objectives

According to the gaps found in previous literature, the present study aims to answer the following questions:

1) Which are the characteristics of the sustainable design YouTube video networks?
2) Which is the role of academia in the diffusion of sustainable design in the video networks?
3) Which are the characteristics of the most popular videos?
4) Which contextual factors are related to the popularity of the videos?

2. METHODS

2.1 Webometrics and Social Network Analysis

Webometrics is defined as “the study of web-based content with primarily quantitative methods for social science research goals using techniques that are not specific to one field of study” [35]. Webometrics is frequently combined with social network analysis [20], where several measurements can help to uncover the structure of the relationships between videos and the impact relevant videos may have on the overall network.

2.2 Operational Definitions and Data Collection

To incorporate more data on developing countries, English and Spanish were chosen as languages for the keywords. A search in Google Trends showed that, although eco design is the correct term according to the ISO Norm 14006, green design and sustainable design were more frequently searched terms. We also wanted to narrow the sample of videos according to their relationship with academia. Therefore, queries containing the words eco, green, sustainable, design, university, and lecture were employed in YouTube Data Tools [29]. Their module of Video Network extracts videos data in a file composed by two sections: a list with the video ID (identifier), label (title), iseed (crawl depth), seedrank (crawl priority ranking), published date, channel, category, number of views, number of likes, number of dislikes and number of comments; and a list of related videos. The file can be read with the Gephi software [4] to calculate network metrics and create data visualizations.

2.3 Data Filtering and Classification

The resulting video files were appended into one for each language. Repeated video IDs were discarded, the most recent information on a given ID was kept and the videos were watched to discard unrelated materials. In the case of the sustainable design English Data Set (SDEN), 2,452 videos were considered as related to sustainable design from a total of 4,537; while in the case of the sustainable design Spanish Data Set (SDES), 1,076 videos were considered from a total of 3,753.

A model for online video’s context was proposed based on Zimmermann et al. [45] as follows: a) We consider their entity (also called design object) as a video; b) individuality was considered as uploaders and speakers of the video; c) time was considered as the date of video upload; d) place was considered as the country’s channel where the video was uploaded; e) activity was considered as the design type shown in the video; f) and network
Sustainable Design in YouTube

centralities were considered as relations. Therefore, videos were classified according to country, design type, uploader (YouTube channel owner) and speaker, besides whether they were related to universities or not.

2.4 Statistical Analyses

Basic statistical analyses were conducted with SPSS [16] and out-link analysis with Webometric Analyst [36]. Data was also examined with Ucinet [5]. Node level t-test can be defined as a t-test with data permutations, therefore, it was carried out between the variable university related and the network centralities to find differences in connectivity. Quadratic Assignment Procedure (QAP) is a Ucinet analysis for categorical, ordinal and interval data, which combines correlation and permutation tests for the independence of matrices. QAP was conducted to find correlations for the videos’ popularity.

3. RESULTS

3.1 Classification of Videos

The number of uploaded videos has been increasing over time, particularly since 2011. From the 2,452 videos related to SDEN, 1,819 disclosed location in 75 countries, mostly the US (862), unclear locations (632), and UK (241). In the case of the 1,076 videos related to SDES, 789 disclosed location in 23 countries, mostly unclear locations (287), Spain (239) and Colombia (180).

1,310 SDEN videos (53%) were related to architecture, 321 (13%) to industrial design, 95 (4%) to graphic design, 355 (15%) to the Mixed area, and 371 (15%) to the General area. In the case of SDES, 527 videos (49%) were related to architecture, 188 (17%) to industrial design, 55 (5%) to graphic design, 189 (18%) to the Mixed area, and 117 (11%) to the General area.

Top video uploaders in SDEN were universities (30%), media channels (16%), education related channels (15%) and business channels (13%). These numbers are consistent with the 1,378 videos (56.19%) found to be related to universities. As for top video uploaders in SDES, they were universities (21%), education related channels (15%), media channels (14%) and business channels (12%). These numbers are also consistent with the 612 videos (56.87%) related to universities.

In the case of speakers in SDEN, the top 3 types were identified as designers (23%), professors (21%) and students (13%); while in SDES, 21% were identified as people, 18% as designers and 12% were in the education mixed category. This implies that education related actors may collaborate more with other stakeholders than in the case of SDEN videos. Notably, 8% of the videos did not feature a speaker in both data sets, showing a product or service instead. Also, 37% of SDEN videos featured at least one woman speaker and 4% of uploaders were disclosed as female. However, in SDES 48% of the videos featured at least one woman speaker and 9% of uploaders were disclosed as female.

3.2 Characterization of Popularity in the Videos

Table 1 shows the popularity metrics of the datasets. In the case of SDEN videos, the average of likes was 26.77 times bigger than the number of dislikes, while the average number of views was 1,272.85 times bigger than the number of comments. As for SDES videos, the average of likes was 20.51 times bigger than the number of dislikes, while the average number of views was 3,460.09 times bigger than the number of comments. This suggests less active interaction with Spanish videos, which is also reflected in the Top viewed videos of each dataset (Table 2).

<table>
<thead>
<tr>
<th>SDEN METRIC</th>
<th>Mean</th>
<th>Standard Dev.</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of views</td>
<td>11,593.14</td>
<td>137,397.25</td>
<td>2,452</td>
</tr>
<tr>
<td>Number of likes</td>
<td>54.76</td>
<td>441.94</td>
<td>2,388</td>
</tr>
<tr>
<td>Number of dislikes</td>
<td>2.04</td>
<td>16.78</td>
<td>2,388</td>
</tr>
<tr>
<td>Number of comments</td>
<td>9.10</td>
<td>85.39</td>
<td>2,444</td>
</tr>
<tr>
<td>SDES METRIC</td>
<td>Mean</td>
<td>Standard Dev.</td>
<td>N</td>
</tr>
<tr>
<td>Number of views</td>
<td>6,674.52</td>
<td>47,359.31</td>
<td>1,076</td>
</tr>
<tr>
<td>Number of likes</td>
<td>20.96</td>
<td>155.23</td>
<td>1,063</td>
</tr>
<tr>
<td>Number of dislikes</td>
<td>1.02</td>
<td>7.98</td>
<td>1,063</td>
</tr>
<tr>
<td>Number of comments</td>
<td>1.92</td>
<td>16.30</td>
<td>1,075</td>
</tr>
</tbody>
</table>

Table 2: Top 5 Viewed Videos for SDEN and SDES

<table>
<thead>
<tr>
<th>SDEN VIDEO</th>
<th>Country</th>
<th>Design Area</th>
<th>Univ. related?</th>
<th>Views</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. GreenBox: Pizza Box…</td>
<td>USA</td>
<td>Industrial design</td>
<td>No</td>
<td>6,097,544</td>
</tr>
<tr>
<td>2. 15 Iconic Residential…</td>
<td>Undisclosed</td>
<td>Architecture</td>
<td>No</td>
<td>1,306,969</td>
</tr>
<tr>
<td>3. The Story of… USA</td>
<td>Industrial design</td>
<td>No</td>
<td>1,150,926</td>
<td></td>
</tr>
<tr>
<td>4. Walmart s New Track…</td>
<td>Undisclosed</td>
<td>Industrial design</td>
<td>No</td>
<td>1,105,190</td>
</tr>
<tr>
<td>5. Ecocouch foldable cardboard… Denmark</td>
<td>Industrial design</td>
<td>No</td>
<td>911,995</td>
<td></td>
</tr>
<tr>
<td>SDES VIDEO</td>
<td>Country</td>
<td>Design Area</td>
<td>Univ. related?</td>
<td>Views</td>
</tr>
<tr>
<td>1. Como hacer una… Mexico</td>
<td>Industrial design</td>
<td>No</td>
<td>1,015,470</td>
<td></td>
</tr>
<tr>
<td>2. Construccion de un… Undisclosed</td>
<td>Architecture</td>
<td>No</td>
<td>793,373</td>
<td></td>
</tr>
<tr>
<td>3. Muebles de material… Chile</td>
<td>Industrial design</td>
<td>No</td>
<td>492,663</td>
<td></td>
</tr>
<tr>
<td>4. Amueblando con pallets… Mexico</td>
<td>Industrial design</td>
<td>No</td>
<td>313,555</td>
<td></td>
</tr>
<tr>
<td>5. Arquitectura sustentable… Argentina</td>
<td>Architecture</td>
<td>Yes</td>
<td>284,718</td>
<td></td>
</tr>
</tbody>
</table>
Spearman correlation in SDEN and SDES showed that the number of views was significantly correlated (p<0.05) with number of likes (.837; .762), number of dislikes (.567; .496) and number of comments (.614; .480). Therefore, number of views was selected as proxy for popularity when conducting most of the other analyses.

3.3 Differences between University-Related and University-Unrelated Videos

Table 3 shows a sample of metrics considered for the Mann Whitney Tests. The results showed some significant differences between the SDEN University-Unrelated group and University-Related group (N1=1051, N2=1401, p<0.05). Number of views (Md1=1263.32, Md2=1198.88, U=697525.50), dislikes (Md1=1231.13, Md2=1167.28, U=693925.50) and comments (Md1=1264.83, Md2=1190.77, U=687009.50) had higher ranks in the University-Unrelated group, which can be interpreted as more interaction with University-Unrelated videos. Likes did not show significant differences.

Regarding design types, architecture videos from the University-Unrelated group had a higher rank (Md1=1278.40, Md2=1187.56, U=681674.50); while industrial design videos related to universities had a higher rank (Md1=1187.32, Md2=1255.89, U=695044), which may reflect a divergence of focus between universities and other interest groups. The General sustainable design area and the Mixed area did not show significant differences among the two groups, pointing to convergence on such areas.

The Mann Whitney test also showed differences between the University-Unrelated group and University-Related group in SDES (N1=464, N2=612, p<0.053). The number of views (Md1=583.26, Md2=504.56, U=121214), likes (Md1=563.26, Md2=508.34, U=124229) and comments (Md1=555.84, Md2=524.50, U=133418) had higher ranks in the University-Related group; while dislikes did not show significant differences. Design areas did not show significant differences, which suggests convergence of sustainable design stakeholders.

Moreover, Australia (Md1=1206.99, Md2=1241.13, U=715724.50), Chile (Md1=527.59, Md2=546.77, U=136924), Colombia (Md1=505.31, Md2=563.66, U=126586), Mexico (Md1=520.26, Md2=552.33, U=133522), Spain (Md1=523.35, Md2=549.98, U=134956), UK (Md1=1185.32, Md2=1257.39, U=692948) and the US (Md1=1117.46, Md2=1308.30, U=621620.50) showed significantly higher ranks on University-Related videos. Argentina (Md1=554.61, Md2=526.28, U=134508) had significantly higher ranks on University-Unrelated videos, while other countries with many videos (Canada with 99, India with 44 and Netherlands with 49) did not show significant differences among the two groups. This suggests that universities in the first group were more active in the diffusion of sustainable design through YouTube than other stakeholders; other stakeholders outside academia in Argentina were more involved; and the third group had both universities and other stakeholders involved.

3.4 Network Centralities

Table 4 shows network metrics calculated with Gephi in both datasets. The low densities and high average path lengths suggest disconnected networks, especially in the case of SDES with its low number of connected components, number of shortest paths, betweenness (number of

<table>
<thead>
<tr>
<th>METRIC NAME</th>
<th>SDEN VALUE</th>
<th>SDES VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of nodes</td>
<td>2,452</td>
<td>1,076</td>
</tr>
<tr>
<td>Number of ties</td>
<td>5,422</td>
<td>2,155</td>
</tr>
<tr>
<td>Diameter</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>Density</td>
<td>0.001</td>
<td>0.002</td>
</tr>
<tr>
<td>Modularity</td>
<td>0.756</td>
<td>0.816</td>
</tr>
<tr>
<td>Connected Components</td>
<td>956</td>
<td>464</td>
</tr>
<tr>
<td>Average Path Length</td>
<td>6.754</td>
<td>7.110</td>
</tr>
<tr>
<td>Number of shortest paths</td>
<td>800,168</td>
<td>68,340</td>
</tr>
<tr>
<td>Betweenness Centrality</td>
<td>1,877,730</td>
<td>388,080</td>
</tr>
<tr>
<td>Closeness Centrality</td>
<td>3.317</td>
<td>2.817</td>
</tr>
<tr>
<td>Degree Centrality</td>
<td>2.211</td>
<td>2.003</td>
</tr>
<tr>
<td>Clustering Coefficient</td>
<td>0.132</td>
<td>0.044</td>
</tr>
</tbody>
</table>
shortest paths that link nodes in the network by passing through a specific node), closeness, degree and clustering coefficient. However, the high number of connected components, the number of shortest paths and betweenness in SDEN can be interpreted as several videos holding the network together.

A descriptive analysis was conducted for top videos in terms of indegree (number of ties directed to a node) and outdegree (number of ties a node directs to other nodes). The ten SDEN videos highest in indegree centrality were mostly about prototypes and integrated views related to industrial design, uploaded by Netherlands and the US. Speakers were mostly students and designers, and seven videos were university related. As for the nine videos highest in outdegree centrality, they were mostly about industrial design prototypes uploaded by businesses and universities in developed countries (notably the US). Speakers were mostly students and eight videos were university related. It should be noted that several top videos had to do with the Shell Eco-marathon.

In the case of SDES, the ten videos highest on indegree centrality were mostly about integrated views on architecture, uploaded from Spain. Moreover, six channels were related to universities. The thirteen videos highest on outdegree centrality were mostly about sustainable design and architecture theory, uploaded by universities and people.

3.5 Node Level T-Test

Table 5 shows a summary of the Ucinet output for Node Level T-tests. Degree ($t = -0.841, p < 0.05$), outdegree ($t = -0.496, p < 0.0005$) and closeness ($t = -0.279, p < 0.05$) were significantly different in SDEN; while only local clustering coefficient ($t = -0.012, p < 0.05$) was slightly significantly different in SDES according to T-test. Therefore, video networks were drawn organized through the Force Atlas algorithm, with node size representing outdegree in SDEN and local clustering coefficient in SDES. University-Related videos are colored in green and University-Unrelated videos are colored in blue. The gray labels close to the networks indicate groups of videos.

In the case of SDEN (shown in the left side of Figure 1), it should be noted that a big, highly interlinked cluster conformed an academia related group, while student

![Figure 1: University Relationship and Network Centralities](image-url)
related videos connected a group of Eco Shell videos with the academic group. Also, videos related to students marked in blue (meaning that they belong to institutions outside university, e.g. high-schools) were as relevant to connecting the videos with the Academia cluster as those related to university students. As for SDES (shown in the right side of Figure 1), Academia was a loose cluster connected with architecture related videos and videos about university students. The term eco diseño (eco design) was so relevant that it had its own cluster. Moreover, the Academia and Students clusters were connected to the Theory cluster (courses through internet and/or provided by stakeholders outside academia).

3.6 QAP Correlations and Out-link Analysis

The number of views was correlated \((p<0.005)\) with closeness \((0.003)\), indegree \((0.008)\), outdegree \((0.002)\) and year \((0.004)\) in SDEN; while in SDES, it was correlated \((p<0.005)\) with indegree \((0.007)\) and year \((0.005)\). Such correlations are not high, which coincide with results by Feroz-Khan and Vong [12], who also found that in-links, hit counts (out links), and off-line fan base and fame play crucial roles in the interaction with top viral YouTube videos. Therefore, an analysis of links outside YouTube for the top 95 videos in terms of number of views was conducted for each dataset. Table 6 shows that Facebook and other social networks were the most frequently linked domains to the videos. In the case of SDEN, a few academic sites were also frequent, while in the case of SDES, only 8 top videos from the Spanish dataset had out-links.

### Table 6: Out-links of 95 Top Videos

<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>LINKS WITH SDEN VIDEOS</th>
<th>LINKS WITH SDES VIDEOS</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="http://www.facebook.com">www.facebook.com</a></td>
<td>70</td>
<td>10</td>
</tr>
<tr>
<td>es-la.facebook.com</td>
<td>33</td>
<td>7</td>
</tr>
<tr>
<td><a href="http://www.slideshare.net">www.slideshare.net</a></td>
<td>23</td>
<td></td>
</tr>
<tr>
<td><a href="http://www.reddit.com">www.reddit.com</a></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td><a href="http://www.scribd.com">www.scribd.com</a></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>twitter.com</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td><a href="http://www.coursehero.com">www.coursehero.com</a></td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>sites.google.com</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td><a href="http://www.taringa.net">www.taringa.net</a></td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>issuu.com</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td><a href="http://www.linkedin.com">www.linkedin.com</a></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td><a href="http://www.academia.edu">www.academia.edu</a></td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>documents.mx</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><a href="http://www.vidinfo.org">www.vidinfo.org</a></td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td><a href="http://www.pearltrees.com">www.pearltrees.com</a></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>mx.answers.yahoo.com</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

4. DISCUSSION

4.1 Individuality and Place

According to our model for online video’s context, we will start the discussion with the individuality dimension in relation to place. Several actors were particularly involved in the diffusion of sustainable design through YouTube in English, e.g. Autodesk, Engineers Without Frontiers, Engineering Explained, Shell, TED channels and The Story of Stuff. As expected based on the literature review, universities from Australia, UK and the US had a relevant role in the network. Regarding countries with more diverse stakeholders, Canada has been pushing sustainability standards, particularly for graphic design, promoting them with seminars [e.g. 32]. Nevertheless, diffusion of such activities and standards has been limited. The Netherlands were the original headquarters of the Shell company, while India suffers from a lack of connection between universities and industry due to the impractical and exclusive nature of its education [23].

As for SDES, Argentina has one of the highest internet penetration rates and one of the highest social media usages in the world [21]. It is also among the top 15 countries in terms of active YouTube users [33], thus the profusion of University-Unrelated videos from this country. On the other hand, the governments of Chile, Colombia, Mexico, and Spain are highly compromised in sustainable development, establishing programs to aid universities and supporting alliances with other stakeholders. Meanwhile, universities are redirecting their educational programs toward complexity [1, 13, 37]. All these efforts are contributing to the diffusion of sustainability in design education, and thus, are reflected in the high number of videos found in the network. Also, in terms of video content, more synergy between education related citizens and other stakeholders was found in SDES than in SDEN.

4.2 Activity: Design Types

Certifications like LEED and BREEAM have been widely diffused among the architecture field in the last decades, as reflected in the number of videos found. However, the sustainability approach in SDEN videos is to engage technology. As most videos come from developed countries where technology is more accessible, cheap and advanced, such results were expected. Nevertheless, an excessive dependence on technology can affect the design process itself, distancing it from its original problem-solving objective and concentrating instead on solving technological issues [40].
A global concern among designers is the distinction between design and stylization. Although design as stylization was present in SDEN, the word design was more strongly connected to beautification in SDES due to the low adoption rate of modern technical methods within design in the majority of Spanish speaking countries. This view is also reflected in SDES architecture videos, where permaculture was a constant topic. Although there is a deep divide between urban and rural architecture in Latin American countries [34], what YouTube viewers are seeking is a return to the rural.

Although Shell Eco Marathon was also present on the Spanish network, the number of related videos was modest, sharing space with other marathons to design houses and kitchens. Fashion was closely related to the under-developed textile sector and small and medium businesses in the Mixed area, which are being supported by governments and industries through several programs in the case of Colombia [13]. Thus, videos related to fashion and Colombian universities were popular.

The distribution of SDEN female speakers per design area shows that they are mostly present on Architecture (51%) and General areas (17%), suggesting that women are particularly involved in theory and integrative aspects of sustainable design. In the case of SDES, the Architecture area also showed the highest female speakers’ presence (44%), followed by the Mixed area (21%). The large number of videos related to fashion design and crafts (contained in the aforementioned area) suggests a prevalence of Spanish speaking informal businesses and self-expression channels. The attractiveness of flexible working hours, extra income and self-agency attracted women in the American continent to use the internet as a promotional tool to create their small world networks despite male backlash [43], but this is especially true in Spanish speaking countries [44].

4.3 Relations and Time: Patterns of Linking and Viewing

In SDEN, the pattern of video viewing goes across universities and other stakeholders, while most popular videos tended to show complex content applied to real life problems. In sum, the results suggest an acceptance of complexity by the viewers. In contrast, the SDES video network is under-developed. There are few connections between universities and other stakeholders, as shown in the Node level T-test. The tests also point to less connection between Spanish network universities from the same country. This could affect the perception of video viewers, who would tend to have less related videos on their feeds and less local-based content.

Among the reasons for the SDES network under-development, there is an inadequate internet infrastructure in Spanish speaking countries, while the availability of easy internet access has flooded the web sphere with content from developed countries. However, psychological aspects should not be ignored. There is a tendency of Latin American YouTube users to comment on English videos, while English speakers rarely comment on Latin American videos [11]. Restrictions on broad band may trigger Spanish Speaking viewers to comment only if necessary, thus choosing the videos they consider the best to comment.

English is widely accepted as the default language for most of the important tasks in the contemporary world, including the internet; however, that implies introducing pedagogical and cultural aspects that contribute to the devaluation of local knowledge and cultures [14]. Therefore, the larger availability of English videos in YouTube combined with a perception of Latin American materials as inferior by both English and Spanish speakers may be playing a part on the low interactivity in the SDES network. This phenomenon could be called a perception of virtual colonialism.

There is also a tendency in internet users from developing countries to choose social media tasks that are faster to complete, and thus cover more diverse topics in one internet session than in the case of developing countries users [42]. Although YouTube was available for Spanish speaking countries since it launched, the oldest date for relevant SDES videos was 2007 instead of 2006. This suggests that relevant videos get outdated faster than in the case of SDEN, which implies that Spanish speaking viewers are keener to seek novelties.

4.4 YouTube and the Diffusion of Sustainable Design

Former discussion sections have mainly dealt with differences between the YouTube networks. This section will discuss similarities. A relevant increase of videos since 2011 points to the influence of the ISO Norm 14006 for the diffusion of sustainable design at a global level. It is also due to such norms that the term eco design became widely used.

The presence of Graphic Design in the videos was small, partly due to the lack of academic programs focused on sustainability in this area. However, a revision on the contribution of Graphic Design to the Mixed and General areas shows animation, packaging and, in more integrative terms, service design and system design. Therefore, the application of Graphic Design to sustainability goes well beyond paper based products.
The relevant role as uploaders of nonprofits, art galleries, associations, award giving organizations, e-schools, forums, foundations, museums, research institutes, etc., is partly due to the decline of control by the institutional design education. This is not an exclusive characteristic of education related organizations. Our hierarchical civilizations are going through a transformation process towards networked civilizations, which are more egalitarian in nature, but increase individual interdependency at the same time [22].

Regarding academia, some project based videos are uploaded in YouTube accounts that are only used for that project. Also, the Mann-Whitney test showed more interaction with University-Unrelated videos and only a few countries where university leadership stands out in the diffusion of sustainable design. Hence, the university related YouTube channels tend to function as document repositories. Also, the role of other Social Networks in the diffusion of sustainable design was highlighted through the out-link analysis, including a few websites that also function as document or link repositories.

This raises the following question: if traditional lectures (with a theory based speaking professor and passive students) are considered boring, why are they still carried on in modern versions like MOOCs and several of the videos found in this study? Some surveys with students across cultures show they are more comfortable in such learning environments [2, 3, 10]. This means we should make a distinction between uninterested and active listening students, who enhance abilities such as initiative, focus and critical thinking with lectures. The rise in popularity of public lectures also supports this approach. However, the lecturer requires fine-tuned abilities to deliver the right amount of theory, methodology and practice. The attention universities tend to give to publications and grants, loading teachers with workload while giving out temporary contracts and low pay are also impacting the quality of lectures [38]. Hence the importance of having a combination of educational contents and delivery methods (on- and off-line) that fosters students’ confidence in their own abilities, sparks their curiosity and tunes with their feelings.

With respect to students, as several of them in both networks posted videos with their prototypes and real projects, it is expected that the adoption of social networks by the younger generations will continue aiding the diffusion of sustainability. Design praxis should involve efforts to close the gap between humans and nature. Especially in the case of designers’ relationship with the objects they design, the materials they use, other living beings involved and the environment, there has to be a congruency between thoughts, feelings and behaviour to improve the design process and, as a result, the design object.

5. CONCLUSIONS

In the present study, we explored sustainable design related networks with a focus on academic output other than global rankings, patents and research papers. Regarding our objectives, we can conclude that:

1) English videos are organized as big groups with multiple interconnections between universities and other stakeholders, while Spanish videos are organized in small groups with few connections between videos (even among those from the same country). However, Spanish speaking academia was more engaged with other stakeholders in the video content.

2) Academic content was frequently linked to websites that function as repositories. Nevertheless, the videos have a high potential for educational usage if they are tailored to designers’ context.

3) Academic content was found to be less popular than content from other sources, and English videos were more popular than Spanish videos. While popular English content tended to show acceptance for complexity, Spanish popular content tended to be focused on a particular project or prototype.

4) Finally, although several patterns of video linking and viewing were uncovered, explanations for the contextual factors impact in popularity were limited. Other quantitative and qualitative analysis such as semantic and sentiment analysis are recommended to deepen the understanding of the interaction with sustainable design related videos.

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