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Information and Communication Technologies for Scientific Dissemination. A Case Study

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Abstract – *The prominence of Information and Communication Technologies (ICT) in the context of the so-called fourth industrial revolution is an indisputable fact. This forces us to rethink the forms and channels of the dissemination of science, technology and innovation, whose relevance, in the same context, is recognized today by all authors. However, the priority of this work has not been identified to the necessary extent by Ecuadorian universities. The university media must respond to this demand, hence the relevance of the case presented in this work: a case that shows how, by integrating ICT into traditional media such as radio, encouraging results can be obtained. Based on the criterion of the possibility of assuming the dissemination of science from the university community itself, a scientific dissemination project was designed at the Catholic University of Santiago de Guayaquil for the university radio of this institution, also supporting its dissemination in its networks social. This article presents some of the results of this study and shows how the integration of the antenna signal, streaming and social networks can strengthen university scientific dissemination, an experience that could be taken as a reference in other university media.*

Key Words: **Information and communication technologies, social networks, scientific dissemination, university radio**

1. INTRODUCTION

This work presents the results obtained when using Information and Communication Technologies (ICT), applied to social networks, in a university radio program, with the aim of disseminating research results of the Catholic University of Santiago de Guayaquil among professors and students of technical, medical and humanistic studies of that institution.

ICTs applied to communication through social networks have become the most revolutionary phenomenon experienced by the media since the arrival of television. (Fernández Bayo, Menéndez, Fuertes, Milan, & Mecha, 2019). More and more people, especially the young segment, are informed through them, and not only as a preferential way, but, frequently, as the only source. Web 2.0 is presented to digital natives as one of the most effective means of accessing science (Prensky, 2001). This author, who is credited with the authorship of the terms "digital native" and "digital immigrant", believes that the difference between these new generations means that they have better access to science in an easy, dynamic, audiovisual way, given their much closer relationship with technology.

Scientific dissemination is essential to consolidate academic dialogue and scientific-technical development (Reyes and Moraga, 2020). In this sense, university institutions should assume as part of their mission what Toharia (2016) calls a work of global acculturation in order to contribute to the socialization of knowledge of the general population. Hence the need to strengthen the visibility of the scientific results achieved in research projects of the Catholic University of Santiago de Guayaquil, (UCSG) the institution under study.

The university scientific production, related to undergraduate and graduate thesis of the institution, is found in digital and physical repositories with not very abundant consultations and even when the results of research projects are made known in spaces open to the community, these informative activities have poor attendance. Hence, both the results that are presented in thesis and those of projects are shared with academic peers, specialized public and groups close to researchers, through the publication of articles in indexed journals, but they are not sufficiently known by the university community and much less by the community in general. On the other hand, the socialization of science through digital platforms, such as blogs, or social networks, could constitute a direct channel for the publication of scientific works without intermediaries.

This preliminary idea was started in this study, in order to assess the results of an experience aimed at strengthening university scientific dissemination by integrating traditional media, in this case: UCSG Radio, with its antenna and streaming signal, and digital spaces in social networks.

To verify its validity, as an initial phase of the investigation, a diagnostic study was carried out on the level of knowledge of the university community about the production of science, technology and innovation generated by the UCSG from 2013 to 2017. The methodological approach was quantitative and

the selected sample comprised a total of 704 subjects, considering both students and professors, who were asked about their knowledge in relation to the research results of the UCSG between the years 2013-2017, as well as the communication channels through which the individuals studied were informed about these topics. (Trelles, Luna, et.al. 2020). The hypothesis taken as a starting point was that the majority of the university community did not know about the entity's investigations. The results of the diagnosis, published in the scientific article "Study of communication and image in university audiences about research results of the Catholic University of Santiago de Guayaquil" evidenced the fulfillment of the hypothesis. Based on the information collected, a science dissemination strategy was designed in order to make public the most relevant results of professors and students in the 2013-2017 period, using the university radio. For this, a radio program was created that was called I-100 (Scientific Research). The production of the program was in charge of the researchers themselves. 53 editions of the program were broadcast, between 2018 and 2019, initially in a traditional way and in 2019, through streaming. The levels of reception of the public, in both media, were the object of the investigation, the results of which are presented in this article.

2. DEVELOPMENT

The dissemination of scientific knowledge is the responsibility of everyone who investigates, because it contributes to the democratization of knowledge, reimburses pre-existing inequalities or communicates results to the community formed by specialists in the field (Espinoza, 2019).

According to Zuluaga (2016), the media little or nothing disseminate scientific initiatives and if they do, their dissemination is not of the best quality. This results in researchers not taking advantage of this type of medium to make their results known and use only specialized channels, through indexed articles (Urrego Zuluaga, 2016). On the other hand, says the aforementioned author, universities are not training professionals with enough tools to disseminate science. These types of activities could be promoted and supported to foster the growing interest in science and technology. Other cases demonstrate this, proof of this is the experience of the Miguel de Cervantes European University of Valladolid, (Díaz Monsalvo, 2020) where radio was the protagonist of a strategy of scientific dissemination with positive results. The experience of such university was implemented with subjects whose excessive theoretical load was difficult for students to assimilate, and the use of podcasts (digital radio files on the web), created in the university's audiovisual laboratories, contributed to improving their levels of learning assimilation (Díaz Monsalvo, 2020).

University radio can be used as an instrument of formal education, with the realization of programs for teaching purposes, complementary to the established study plans (Díaz Monsalvo, 2020). This is also part of the dissemination of science in universities, which integrates everything from teaching itself with its students to high-flying scientific results.

2.1. Scientific communication strategies with social networks

The importance that the Internet has acquired as a source of scientific information, in the opinion of authors such as Valverde-Crespo, De Pro Bueno, & González-Sanchez, (2020), justifies the need for all citizens to have skills that allow them to evaluate the contents and its reliability. Moreover, the possibility it offers for the creation of digital content and its high number of users, make the internet a current scenario for the socialization of knowledge. Although it is fair to point out that in many countries the use of technology has limitations and this conspires against such socialization.

It is pertinent to refer to the situation presented by Ecuador according to data published by the National Institute of Statistics and Censuses (INEC) (Dávalos, 2020) on the use of information and communication technologies in the country in 2019. According to INEC Only 45.5 percent of households in the country have Internet access and households that have a desktop computer decreased 1.2 percent compared to 2018. However, the percentage of households with a laptop increased by 4, 3%. Regarding the most used social networks in the country, the aforementioned source identifies Facebook as the first with 55.4% of users, followed by WhatsApp with 52% of users and Instagram with 18.2% of those surveyed. (Dávalos, 2020). Regarding the penetration of the internet in Ecuador, Espín and Freite (2019) sustain that 6 out of 10 users who access the internet every day, do so to download games, music, videos, images, social networks and others. Of these, 7 out of 10 users are between 10 and 18 years old. However, only 31% of minors declare that they regularly visit educational or cultural resources.

Universities are beginning to be aware of the importance of these channels to approach the general public and especially the younger ones, eventually, their target audience. However, although most institutions have increased their 2.0 presence, it is an ineffective presence if we take into account the connectivity and intensity data. This emerges from an analysis carried out in Spain (López and Olvera, 2016). The use of blogs and social networks in the field of universities and scientific research, as communication resources for science and technology, increase the impact and visibility of publications and improve the digital reputation of research staff.

2.2. About the object of study: Program I-100 of Radio UCSG

The Catholic University of Santiago de Guayaquil, created more than 12 years ago, a system of communication media in

order to foster and promote the work of the institution in its various dimensions. In a short time, these media were creating a program with a lot of content, of an academic nature at the service of the general public. On February 20, 2008, UCSG Radio was launched, creating a link between the university and the community, providing it with a highly needed service. On the university radio, topics related to university studies and their activities were addressed, but science was scarcely disseminated in them. The studies, in general, were more interested in talking about their academic or administrative activities. Hence the challenge: using a space for the socialization of science in a station that had good academic content, but which lacked to disseminate Science, Technology and Innovation, new knowledge, whose production the university itself develops and encourages.

This purpose takes shape with the creation of the I-100 ("*Investigación - científica*" -Scientific Research) program, in order to disseminate science through the academic university media, and with the aim of responding to the need of disseminating science effectively. The radio project was planned seeking a balance between the need for simplicity of discourse and the complexity inherent in the contents of research results, a paradox present in scientific dissemination since its beginning.

The schedule established for the transmission of the program was Saturdays at 10:30, with "reprise" on Sundays at 5:00 p.m. Its frequency: once a week; duration: 30 minutes; thematic: educational-training content. The station's coverage reaches the provinces of Guayas, Santa Elena, El Oro, Cañar, Los Ríos and surrounding areas. A program duration of 30 minutes was determined, due to the presentation of content different from that applied by other radio stations. The time was organized in two blocks of 13 minutes each.

3. Methodology

In order to strengthen the scope of the program, a communication strategy, that incorporated the social networks as Facebook, Twitter and Instagram, was implemented. In these networks, promotions of upcoming programs and their topics were also carried out. In this way, a constant interrelation with the public interested in the program was achieved. Moreover, the I-100 UCSG web page was created.

In 2018, a preliminary evaluation of the strategy was carried out, as an antecedent to the evaluation carried out between 2019 and 2020 through diagnostic research aimed at determining the change produced in the reception levels of the I-100 program, as well as the behavior of the interest and knowledge about the topics addressed.

A single variable was considered: Reception of the I-100 program, with indicators that allow to explore into the aspects related to it, among them: levels of increase in knowledge of the program; levels of increase in listening to the program; knowledge of topics on scientific results that are addressed; preferences in terms of listening media; preferences regarding frequency and hours of transmission and behavior of social networks

Among the research instruments applied, the monitoring of the reception level of the internal and external public, based on the rating analysis and the survey was used. The sample was calculated with a confidence level of 95%, a margin of error of 4.7%. The population for the research was taken as students and professors of five selected schools according to their fields of knowledge, with a total of 382 professors and 14,334 students. The resulting sample was 204 professors and 290 students, with the composition shown in Table 1.

Table -1: Total of students and professors surveyed

SCHOOLS	# STUDENTS	# PROFESSORS
Technique for Development	37	28
Business Specialties	56	42
Medical Sciences	101	67
Philosophy	56	39
Architecture	40	28
TOTAL	290	204

Own Source

The digital platforms used for the dissemination of the I-100 program were Facebook, Twitter and Instagram. Their behavior was monitored by analyzing the number of followers in each one, the interaction of the public, the traffic of visits and the categories of the best post of each month. The study of the behavior of the I-100 UCSG website was carried out by analyzing the number of visits, views and public interest in podcast consumption.

4. About the results of the inquiry

The integration of the analysis of results shows that of the total of 290 students surveyed, in 2019, 28.8 percent of students acknowledge having listened to the program, while 44 percent of professors offer a similar response. Although these data are not very high, growth was evidenced in relation to the results of the previous study carried out in 2018.

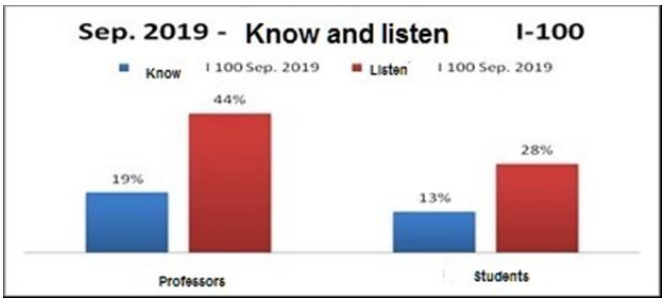

Chart- 1: General result of the reception monitoring applied in September 2019 (strategy application), in the five schools.

Below there is a summary of the results by school, according to the established indicators.

4.1. Levels of increase in knowledge of the program

The results of the research show an increase in the knowledge on the part of the selected audiences, of the radio space studied.

38 percent of the total sample of students from the School Technique for Development, claim to know the I-100 radio program while 62 percent say they do not know it. Similarly, 38 percent of the students indicate having listened to the program, while 62 percent answered that they had not. Of the professors surveyed, 58 percent indicate they do not know the program, while 42 percent do know about I-100. Of the professors who said yes, 28 percent say they have heard while, 72 percent say they have not listened to it.

The Technical School, in general terms, improved in their level of knowledge about the radio program, only 16 percent of the students said in the first survey they knew about the program, while 38 percent of the students did so in the second survey. While in professors the increase was from 30 percent to 42 percent in the level of knowledge. In the School of Business Specialties, knowledge of the program was declared by 25 percent of the students surveyed, a figure that rises in relation to the 10 percent of the first survey. In the professors, there was a progress from 14 percent to 64 percent, in the first and second surveys respectively, in terms of the level of knowledge. In other words, knowledge of the program has increased substantially in this group.

In Architecture, students who claim to know the program rose from 0 percent to 21 percent. Although it is not a more desired result, it does reflect an improvement. On the other hand, in professors the increase was from 24 percent to 42 percent. As to the School of Medicine, it presents an increase in knowledge of the program in its surveyed students that ranges from 17 percent to 27 percent and in its professors, from 20 percent to 34 percent. Finally, in the School of Philosophy, an improvement was registered in students from 14 percent in the initial diagnosis to 38 percent in knowledge of the program and in their professors, an increase from 12 percent to 38 percent.

4.2. Increase levels of program listening

The reception levels also register an increase in the consumption of I -100 program. The following table shows the results.

Table -2. Results of reception levels in 2018 and 2019

Schools	Students reception levels 2018 survey (%)	Students reception levels 2019 survey (%)	Professors reception levels 2018 survey (%)	Professors reception levels 2019 survey (%)	Percentages of total integrated increase
Technique for Development	16	38	26	28	24
Business Specialties	4	23	36	64	47
Architecture	0	21	19	29	31
Medical Sciences	15	20	21	34	18
Philosophy, Humanities and Educational Sciences	14	27	3	38	48
Total percentages	9,8%	28,8%	21%	44%	

4.3. Knowledge of topics about scientific results

Regarding the topics of greatest interest, the ones chosen were those linked to each university study and school.

In Philosophy, professors preferred communication and education issues while students, mainly in Psychology, suggested health issues, referring to those related to mental health.

Of the students' preferred content in detail, 35 percent answered health topics, 28 percent about communication, and the rest, education, technology, environment. On the other hand, of the topics preferred by professors, 33 percent correspond to education, 19 percent to innovation and

technology, followed by business and production, environment and tourism.

In Medicine, both students as professors chose as subjects of preference those related to health. While in Architecture, in the first survey the topics of greatest interest were environment, education, business and production, at present the entire sample stated showed preference for those related to construction.

On the other hand, the topic of preference of all the professors, was in the first place, construction, followed by technological innovation, education and the environment, 25 percent each.

In the School of Business Specialties, both students and professors chose as topics of preference to listen to in a radio program those dealing with business and production. As for professors, in the first survey the topics of greatest interest were, curiously, health issues, followed by environmental media, while in the second survey preferences have changed, leaning with 33 percent for business and production.

Regarding the topics of preference, from the Technical School, 25 percent of the students surveyed indicated that they would like to listen to agricultural topics, 25 percent the environment, 21 percent innovation, and 29 percent business and production.

The topics of interest to professors are currently: Agriculture, 18 percent and Environment with 18 percent, followed by technological innovation with 14 percent and 0 percent business and production.

In the students' first survey, the topics of greatest interest were health, for 10 percent, environment, 6 percent, education, 6 percent, business and production, 6 percent, and 66 percent did not respond; while in the last survey the health issue leads 60 percent. While the professors, in the first and second surveys chose the topics of greatest interest to doctors and education.

4.4. Listening preferences

In general terms, the most popular media continues to be the traditional one, using the 1190 am dial; the internal audience, that is, the university community, replied that in addition to this media, in less quantity, listening to the program through the web. On the other hand, the external audience registers listening to the program via the web through the web page's podcast. Therefore, a more aggressive campaign is suggested to disseminate the program via digital platforms within UCSG.

Table -3: Listening media for I-100 Program

School	Population	Media
Technical	Professors	Radio
	Students	Web
Business	Professors	Radio
	Students	Radio
Architecture	Professors	Radio
	Students	Web
Medicine	Professors	Radio
	Students	Radio
Philosophy	Professors	Radio
	Students	Radio

Own source

In the Technical School, students have indicated that the most used media is the website with 57 percent, while 43 percent prefer the traditional way, that is, through the radio. On the other hand, professors prefer to listen via antenna on the 1190 AM dial with 60 percent. However, there is an interesting consumption of professors who prefer it via the web with 40 percent, taking into account that the consumer in this case is an adult audience (professors).

On the other hand, the School of Business Specialties identifies the 1190 AM signal as the most listened to by students, with 6 percent compared to the online route for 4 percent. The remaining 90 percent of the sample did not respond. The professors stated that the preferred route of consumption is the antenna, on the 1190 AM dial with 73 percent and 27 percent indicated that they prefer the web.

In the School of Architecture, in the option of the preferred day, in the first phase, everyone restated that they did not hear or know about the program, in the second survey, they did identify the program and all the subjects confirmed that the day most listened to is Saturday. 75 percent of professors indicated that they have heard it on traditional radio and 25 percent on the website. Regarding the audience, 71 percent of the students indicated that they listen to it through UCSG Radio, and 29 percent through the web. And the professors responded that the most optional means is the 1190 AM dial, for 69 percent and through streaming or websites with 31 percent.

In Philosophy, all the students surveyed listen to it through the radio and through the antenna, in the morning.

Professors chose the web as a means of listening in the first phase with 3 percent and 97 percent did not respond, while in the most recent survey it was found that 70 percent did not listen through the 1190 signal. A.M.

4.5. Assessment regarding frequency and transmission schedules

Both the students and professors surveyed have shown interest in consuming this kind of program on weekends so that it does not interfere with their class timetables.

According to the survey, the students of the Technical School chose as days of preference to tune in to the radio program, Saturdays (86 percent) and Sundays in the morning (14 percent). Regarding the day of preference of professors to consume the product, Saturday continues leading as the preferred time with 80 percent and 20 percent favors Sundays.

In Business Studies, of the students who have tuned in to the program, 6 percent prefer broadcasting on Saturdays and 4 percent on Sundays; the other subjects do not respond. In the case of the professors, only 11 people responded in relation to the day of preference, of them, 91 percent say they prefer Saturday and 9 percent Sundays. The professors of the School of Architecture chose Saturdays and Sundays in the morning, while all the students prefer Saturday.

Medical Sciences students said that Saturday or Sunday, in the morning, is the best time. In the option of the preferred day, in the first phase, 8 percent chose Saturday and, Sunday, 7 percent. 85 percent did not reply. In the second survey among students, Saturday leads, with 71 percent. And in the professors, in the first phase Saturday leads, with 20 percent and Sunday with 15 percent. 65 percent did not respond; and in the current survey, 50 percent listen to it on Saturday and 50 percent on Sunday through the antenna, in the morning hours.

Philosophy students chose Sundays while professors Saturdays, both in the morning. In a comparison, students in the first phase preferred Saturdays with 8 percent, Sundays with 6 percent, and 86 percent did not respond. In the current survey they chose Sunday with 75 percent. For professors, the preferred day is Saturday with 80 percent today over 3 percent in the first survey.

4.6. Results of monitoring the social networks of the I-100 program

During the implementation of this study, a monitoring was carried out of the social networks used to disseminate content, as well as the web page created to publish the podcast of the programs.

In a general sense, there was an increase in activity in networks, taking the month of November 2018 as an example, it can be seen that the number of tweets was 101, gaining a total of 173 followers and 360 interactions generating a previously non-existent movement in the account. On the other hand, Facebook metrics also reveal interesting results with 22 posts in the same month, 244 interactions were achieved from the 886 followers of the account. In the same way, the Instagram account was also created, with only 12 publications, 82 followers and 131 interactions in the same period.

In this way, it is evident that if there is constant movement in the networks and the blog of the program, the community interested in scientific issues would grow much more, thereby strengthening the scope of the program. The exclusive characteristics of the Internet such as the breakdown of time and space, its multimedia nature, hyper textuality or interactivity make it an ideal medium for the organizations promoting scientific activities to disseminate them to a more generalized potential public.

5. CONCLUSIONS

The research revealed that the use of radio achieved interesting results and that it could be a starting point for important advances in the dissemination of science and technology topics of the research carried out by the university in different areas: student sector, professors, academic departments and / or agreements with entities that promote education at the national and international level.

When basic communication elements were used in the radio, with clear objectives: format, times, content, presenters and most importantly, credibility and empathy with the audience using colloquial language, a host who knows the issues, noticeable results needed for a change, were achieved.

The results of the research show an increase in the knowledge and consumption of the science, technology and innovation program and contents, as a result of UCSG research, by the selected audiences, as well as a relative increase in the reception of I -100 program, object of study of the research. It was found that the dissemination of the program among students and professors, using social networks, achieved outstanding results: first, many of them began to get to know the radio, then the I-100 program, in addition to the contents where they talked about what they had investigated, achieving a motivation and a recognition that, until that moment, was valued by few people.

It was evidenced the need of internal dissemination channels for knowing the I-100 program and its content, as well as other similar programs that may be produced. This was observed in a particular way when verifying the results of the reception of I -100 during the month of July 2019, in which, as part of the strategy, coverage of scientific events of the Catholic University was carried out, in which the program was promoted among the participants.

The topics of greatest interest, on the part of the audience, were related to areas familiar to each sector, that is, the utility of fiber optics was of interest to the technicians; construction material, engineers and architects; treatment of diseases to doctors; and, social issues to communicators, etc. Although there was also some interest in topics other than their knowledge area.

The conclusions of this research are clear and point out to the possibility of strengthening the dissemination of science, technology and innovation through most appropriate formulas without creating new dependencies or budgeting huge resources in universities to achieve this.

Higher education institutions, supported by technology, must have aerial and online media (television and radio) and they have done little or nothing to create space for scientific dissemination through these media.

The investigation showed that the combined use of a traditional medium such as radio, which does not require great resources, and communication on social networks for the dissemination of research results from higher education institutions, could constitute a feasible option to strengthen socialization of scientific knowledge in the university community and society in general.

The experience that has been presented demonstrates this and it could constitute a benchmark for other Ecuadorian and even Latin American universities.

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