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Social distancing in the face of COVID-19: simulation of the maximum capacity of people through PHP

Distanciamiento social ante la COVID-19: Simulación del aforo máximo de personas mediante PHP

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Abstract

Confluence of people in internal or external areas considerably increases transmission of COVID-19, because the social distancing established by the health system is not observed. The objective of this work was to use programming techniques with the PHP language (hypertext preprocessor), for developing an application that simulates the maximum number of people who can enter an internal or external area. The methodology enabled recognizing common internal and external areas, configuring the development environment, coding, simulation proposal and simulator execution where a practical case and ten places were evaluated to determine its reliability. The simulator provided the maximum people capacity of an internal or external area, honoring a social distancing of 2 m. Results enabled to know that using information technologies through programming techniques and the PHP language constitutes a technological alternative to fight against the spread of the virus.

Keywords: social distancing, PHP, programming techniques

Resumen

La confluencia poblacional en áreas internas o externas incrementa considerablemente la trasmisión de la COVID-19, por no respetar el distanciamiento social que establece el sistema de salud. El objetivo de este trabajo fue hacer uso de técnicas de programación, empleando el lenguaje PHP (preprocesador de hipertexto), para el desarrollo de una aplicación que simule el aforo máximo de personas que pueden ingresar a un área interna o externa. La metodología permitió el reconocimiento de áreas internas y externas comunes, configuración al entorno de desarrollo, codificación, propuesta de simulación y ejecución del simulador donde se ha evaluado un caso práctico y diez lugares para determinar su confiabilidad. El simulador brindó el aforo máximo de personas que pueden ingresar a un lugar de área interna o externa cumpliendo el distanciamiento social de 2 m. Los resultados permitieron conocer que el uso de las tecnologías de información a través de las técnicas de programación y el lenguaje PHP contribuyó en ser una alternativa tecnológica para la lucha contra la propagación del virus.

Palabras clave: distanciamiento social, PHP, técnicas de programación

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1. Introduction

Due to the presence of COVID-19, the world has taken different control measures, such as social distancing in public and private spaces, which has led to new communication ways and characteristics in which human beings cannot interact until the advent of a new normality [1]. Commercial places, financial institutions, recreation areas and governmental institutions, after closing their doors have resumed their business and commercial activities where one of the fundamental criteria for reopening is to determine the maximum people capacity. Such control measure converges with the appropriate use of masks and rational hand wash with water and soap or alcohol [2]. In this scenario it is important to manage areas of interaction, as well as knowing the number of people that can enter a public or private place according to the diameter of each infrastructure taking into consideration biosecurity regulations associated with the social distancing between one person and the other.

This information may be known through a simulation that provides the maximum capacity of people that can access and interact in open or closed spaces honoring biosecurity measures. The present research work intended to demonstrate that programming techniques are one of the means available to evaluate and simulate the maximum capacity of people in places of low, medium and high confluence of people. This exercise helped public and private sectors in a more agile and optimal way, to honor biosecurity regulations and to reduce possible infections of COVID-19 that may propagate due to typical people activities. Such activity contributes with the socio-economic sector and to a government-citizen transformation, developing better proximity and reliability links, mainly in the economic sphere and in the attention of essential services that people permanently use [3].

Research works about social distancing between one person and another to prevent COVID-19 infection were analyzed to address this study. Detection of people and identification of objects and the distance between them was revised, with the purpose of developing an application that involves detection and estimation of the people that would be more exposed to become infected by this virus [4]. However, this cannot be possible without analyzing it from a wide and dynamical context, and with a socioeconomic focus where the use of the resources available and the engineering cosmovision gets involved in the solution of common problems, thus contributing to strengthen productive and economic sectors. Consequently, the use of information technologies (IT) has become a daily means where people have a fundamental role in organizations which enable them to adapt to new changes, generate proposals and provide immediate solutions [5].

Humans may develop a cross-sectional view of world's reality, with the existing solutions to face COVID-19, with resilient characteristics and horizons, encouraging new proposals, context, collaborative ways and techniques that safeguard the integrity of population. ICTs may provide solutions to this new scenario [6]. Even though the COVID-19 pandemics paralyzed access to global systems, it focused on health care through unprecedented blockades and forced social distancing, quickly accelerating the development of these digital technologies to fulfill different worldwide requirements for health attention [7]. For this reason, it is intended to use emerging technologies to prevent its propagation [8]. Control and mitigation of COVID-19 requires involvement of many sectors, including general public. On the other hand, application technologies provide the means through which these different sectors may innovate, communicate and act quickly [9].

If control measures are not applied to reduce the number of contacts at particular places, this may have influence in the evolution of the pandemics. Consequently, it was important to identify the places of greater contact and determine the weight of propagation that has influence on the possibility to have available and make appropriate use of the resources. In this sense, the use of simulation models, as detailed in the current research work, may contribute to decision-making [10]. The findings from a systematic review of 172 studies (44 comparative studies; n = 25,697 patients) about COVID-19, severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) provide the best available evidence that current policies of at least 1 m of physical distance are associated with a great reduction in case of infection, but distances of 2 m may be more effective [11].

In view of the above, the general objective of this research study is to use programming techniques with the PHP language, by means of reference variables such as the length and width of an internal or external area, which enables simulating and knowing the number of people that may be admitted honoring social distancing.

2. Materials and methods

Figure 1 illustrates the methodology considered for developing the web application, to enable knowing the maximum people capacity that may access internal or external areas honoring social distancing.

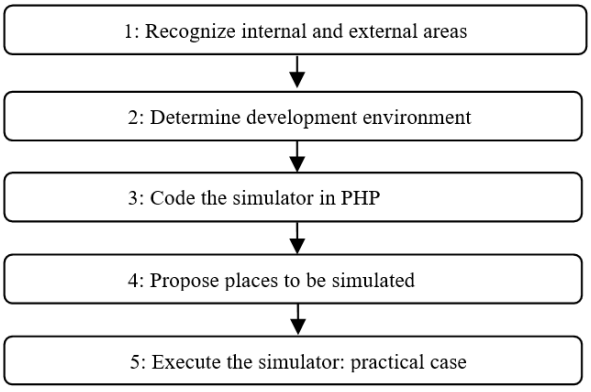

Figure 1. Methodology

2.1. Recognize internal and external areas

Internal areas are closed spaces or spaces with limited reduced surface, while external areas have larger dimensions and more access to people. Those spaces are known as indoor or outdoor environments. At present, the access to this type of areas or environments is subject to recommendations to mitigate the propagation of COVID-19. These are based on social distancing, which implies not having close contact with another person; a distance between 1 and 2 m is recommended, as defined in different countries [12].

Throughout all the different activities carried out by humans, they visit indoor places such as restaurants, shopping malls [13], transportation terminals, academic institutions, public-private institutions, bars, cafeterias, libraries, museums or cultural centers, a movie or a theater, a church or spiritual center, their house (or one of its rooms), the home of another person (or one of its rooms), a covered sport facility; they also visit outdoor (external) places such as a square, a urban forest, a viewpoint, a sport field, a street or a section of it, a park, a neighborhood and the terrace of a bar / cafeteria / restaurant [14].

Dispersed population that converges at the aforementioned places is linked to they type of geographical area. Indeed, residents of rural communities show greater levels of identity with the place they live in than residents of cities [15], behavior which is reflected in a high access traffic to shopping malls, restaurants and public institutions. This scenario is significantly affected by a weak and not moderate calculation of the maximum people capacity; this situation represents a lack of identification and evaluation of the available spaces that fulfill biosecurity regulations.

At a local level, the Government should establish control measures that foresee and contribute to the orientation of public and private places, strengthening management of its operations to enable ensuring social distancing and implementing cleaning, disinfection and personal protection actions [16].

2.2. Development environment

At present, PHP is one of the most popular programming languages, commonly used by the open-source community because it is an industry for constructing big web applications [17]. It is a compatible, scalable, secure and multidisciplinary programming language that enables developing agile, optimal and immediate applications based on the requirements of society.

Appserv 8.5.0 is used as an interpreter; it is an open-source tool for the Windows operating system that integrates Apache, MySQL and PHP, taking into account the 5.6.26 version of PHP. For coding, the SublimeText [18] text editor enables developing a web application to simulate and determine the maximum people capacity of an internal or external area honoring the mandatory social distancing.

2.3. Coding of the simulator in PHP

At the coding stage, programming techniques are used to exploit their expression, order and sequence when writing instructions and sentences. Priority rules [19] are also known for achieving optimal results and solving common problems [20], which contributes in the development of a web application to simulate the maximum people capacity of internal or external areas, honoring biosecurity regulations.

Table 1 describes the use of the five variables created, as well as the operationalizations that specify how these variables interact to give the inputs and outputs that define the behavior of the simulator according to the dimensions entered, as seen in Figure 2.

Table 1. Description of the variables used in simulator coding

N°	Variables	Description
1	$area_lg	Width of the surface/area.
2	$area_an	Length of the surface/area.
3	$area_m2	Operationalization between variables 1 and 2 (product).
4	$distanciamiento	Variable with an assigned value of “2” m.
5	$operacion	Operationalization between variables 3 and 4, where variable 4 is divided by “2”.

Table 2 explains the predominant instructions, sentences and labels for coding the simulator.

Table 2. Predominant instructions (I), sentences (S) and labels (L) for coding the simulator

Index	Type	Description
for	I	Loop that self-generates the results of the operationalization of the defined variables
if	S	Sentence that conditions the result
else	S	Sentence that is executed when one or more conditions are not met
table	E	Label that shows a table
img	E	Label that shows an image

```
<?php
$area_lg=20;
$area_an=8;
$area_m2=$area_lg*$area_an;
$distanciamiento=2;
$operacion=0;
$operacion=$area_m2/($distanciamiento*2);
?>
  <h2> Simular el Aforo Máximo de Personas</h2>
<h2>El aforo para un Área de
<?php echo   $area_m2; ?>  m2 es de
<?php   echo $operacion; ?> Personas.</h2>
<table border="1" cellpadding="0"
cellspacing="0" width="60%">
<?php for ($j=0; $j <$area_lg ; $j++) {
if($j%2==0){
?>
<tr>
<?php for ($x=0; $x <$area_an ; $x++) { ?>
<?php if($x%2==0){  ?>
<td align="center"><img src="distance90.png"
height="80px" ></td>
<?php
}else{  ?>
<td align="center"> </td>
<?php } } ?>
</tr>
<?php
}else{
?>
  <tr>
<?php for ($i=0; $i <$area_an ; $i++) {
if($i%2==0){
?>
<td align="center"><img src="person.png"
width="16px" height="16px"></td>
<?php
}else{
?>
<td align="center"><img src="distance.png"
width="80px" ></td>
```

Figure 2. Coding of the simulator in PHP

The images shown in Figure 3, namely, *distance90*, *distance* and *person*, are used for the operation of the *img* label.

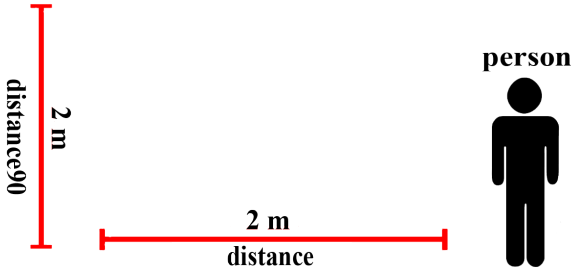

Figure 3. Images used in the coding

2.4. Places proposed for simulation

A simulation is an artificial representation of a real process [21], where it is simulation and not reality, and a special objective is sought [22]. In this context, ten places with the internal and external areas most commonly and recurrently visited by the people residing in the Region, Province and District of Piura – Peru, to know the maximum people capacity that may be admitted to each of the places shown in Table 3, honoring the biosecurity regulations.

Table 3. Places with simulated internal and external areas

N°	Place	Area	Width m2	Length m2
1	Restaurant	Internal	8	15
2	Church	Internal	10	100
3	Cafeteria	Internal	5	20
4	Bar	Internal	6	20
5	Commercial store	Internal	4	8
6	Square	External	85	82
7	Park	External	72	225
8	Sport field	External	26	34
9	Recreational center	External	50	400
10	Avenue	Externa	12	100

2.5. Execution of the simulator: practical case

In this stage, initial tests were carried out involving execution of the simulator, where it was sought to know the maximum people capacity that may be admitted to the waiting area of the COVID-19 vaccination facility of the Universidad de Piura, identified as an external outdoor area, with a length of 12 m and a width of 10 m.

The results of the simulation for this first test case indicate that there is an area of 120 m^2, and that the maximum people capacity is 30 people honoring a social distancing of 2 m, as shown in Figure 4.

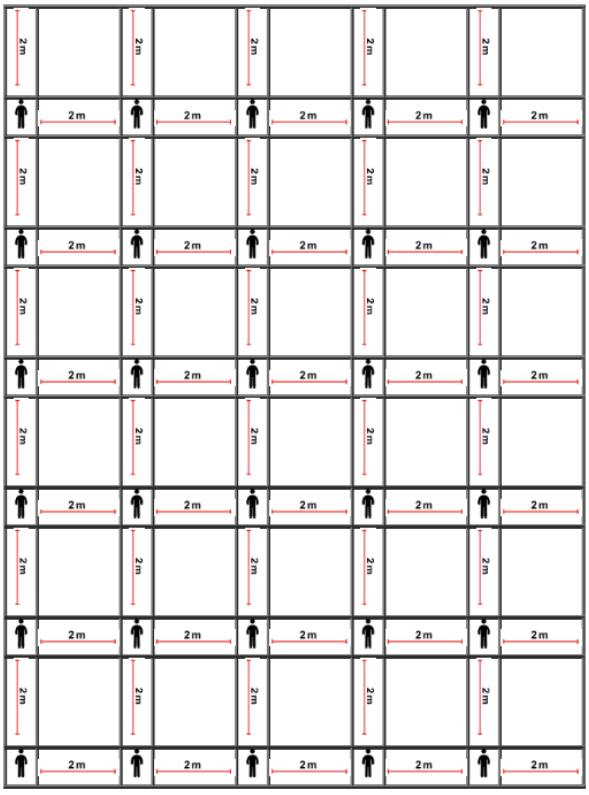

Figure 4. Simulation results

It may be seen that the parametrization of the admission variables is not absolute, as well as the diameter for honoring the social distancing; the composition and form of the results will depend on the admission data.

3. Results and discussion

Table 4 shows the results of the ten places identified, and it may be observed in the column Maximum available people capacity that results are favorable, considering the percentage of available area, which enables obtaining real results and knowing the reliability of the web application, provided it is clear that 100 % of the space is not always available in internal or external areas for free access of people.

According to the results of Table 4, it can be also seen that places with external areas exhibit better predominance in the use of the simulator that enables determining the maximum people capacity honoring social distancing; however, for places with internal areas it can be seen that there are some limitations due to the presence of objects, accessories and others, where it should be first obtained the occupied and available area to achieve more reliable results.

Table 4. Results of maximum people capacity in places with internal and external areas

N°	Place	Type of area	Width m	Length m	Area m^2	Simulated maximum people capacity	Available area	Maximum people capacity
1	Restaurant	Internal	8	15	120	30	50%	15
2	Church	Internal	10	100	1000	250	80%	200
3	Cafeteria	Internal	5	20	100	25	65%	16
4	Bar	Internal	6	20	120	30	60%	18
5	Commercial store	Internal	4	8	32	8	60%	5
6	Square	External	85	82	6970	1742	85%	1481
7	Park	External	72	225	16 200	4050	85%	3443
8	Sport field	External	26	34	884	221	90%	199
9	Recreational center	External	50	400	20 000	5000	90%	4500
10	Avenue	External	12	100	120	30	95%	29

Recall that in places such as restaurants, cafeterias, bars and commercial stores there are spaces where people should wait to access the service or request being made. In this context, the simulator represents a contribution suitable to be used to know the maximum people capacity that may be admitted to places with internal and external areas, making available for entrepreneurs and public sector technological tools that promote honoring biosecurity protocols, articulated with the socioeconomic sector that provides people's source of livelihood.

It is deducted that the use and application of the simulator will contribute and boost the identification of places with internal areas due to the due to the lack of pipes in these places of population recurrence.

The results obtained regarding the simulated maximum people capacity and the available maximum people capacity show a variation of the available area which depends on the place where the simulator is used to determine the maximum people capacity, as seen in Figure 5.

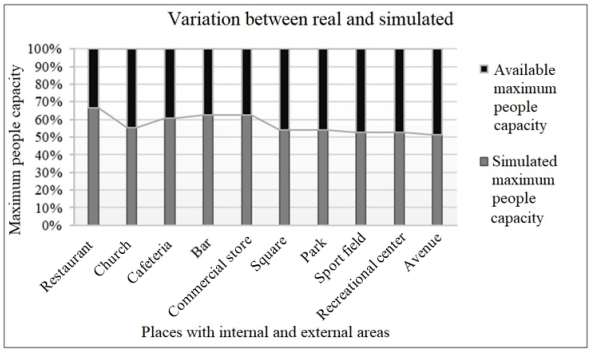

Figure 5. Simulation results

In this sense, to obtain reliable results it is important to know the available area, ignoring factors that limit access to people that seek to interact inside or outside a place, with the purpose of honoring social distancing according to biosecurity regulations.

4. Conclusions

The results given by the simulator for the practical case stated and the ten places evaluated enabled knowing the maximum people capacity that may be admitted to a place with internal and external areas, honoring the social distancing of 2 m. For effective use of the simulator, it is necessary to know the area occupied by objects, accessories and others in the place being evaluated.

The simulator visually shows the certainty, order and security of knowing how to calculate the maximum people capacity that may be admitted in places with external or internal areas, taking into account that places with external areas are the most appropriate for convergence of people since they have a greater available area and smaller number of obstacles that might reduce the maximum number of people that may be in an environment.

The present research work may be strengthened locating a system of video cameras inside or outside places with greater recurrence of people, to know the number of people that have come in or gone out, and those how are in the place. This product may be developed using the PHP programming language and, as an alternative, Python with artificial vision techniques.

Therefore, it is demonstrated that the application of the techniques and the PHP programming language provides a promising route to fight against COVID-19, through easy handling, stability, compatibility and reliability of the results.

References

[1] B. L. Valle Canales and J. C. Chavarría Hernández, "Communicative habitus and social distancing. Effects on the modes of sign production during the COVID-19 pandemic," *Comunicación y Sociedad*, vol. 18, pp. 1–27, 2021. [Online]. Available: https://doi.org/10.32870/cys.v2021.7953

[2] C. Maguiña Vargas, "El COVID-19 en el Perú," *Revista de la Sociedad Peruana de Medicina Interna*, vol. 33, no. 4, pp. 129–131, 2020. [Online]. Available: https://doi.org/10.36393/spmi.v33i4.558

[3] A. Ziccardi and D. Figueroa, "Mexico City: Housing conditions and social distancing imposed, COVID-19," *Revista mexicana de sociología*, vol. 83, pp. 31–60, 2021. [Online]. Available: https://doi.org/10.22201/iis.01882503p.2021.0.60068

[4] C. V. Niño Rondón, S. A. Castro Casadiego, B. Medina Delgado, D. Guevara Ibarra, and J. Gómez Rojas, "Procesamiento a imágenes de video para verificación de distanciamiento social durante la pandemia de la COVID-19," *Revista Logos Ciencia & Tecnología*, vol. 13, pp. 116–127, 2021. [Online]. Available: https://doi.org/10.22335/rlct.v13i1.1305

[5] C. L. Vidal-Silva, A. Sánchez-Ortiz, J. Serrano, and J. M. Rubio, "Experiencia académica en desarrollo rápido de sistemas de información web con Python y Django," *Formación universitaria*, vol. 14, pp. 85–94, 2021. [Online]. Available: http://dx.doi.org/10.4067/S0718-50062021000500085

[6] M. Guisado-Clavero, S. Ares-Blanco, and L. D. Ben Abdellah, "Using mobile applications and websites for the diagnosis of COVID-19 in Spain," *Enfermedades infecciosas y microbiologia clinica (English ed.)*, vol. 39, no. 9, pp. 454–457, 2021. [Online]. Available: https://doi.org/10.1016/j.eimce.2021.08.003

[7] W. Y. Ng, T.-E. Tan, P. V. H. Movva, A. H. S. Fang, K.-K. Yeo, D. Ho, F. S. S. Foo, Z. Xiao, K. Sun, T. Y. Wong, A. T.-H. Sia, and D. S. W. Ting, "Blockchain applications in health care for COVID-19 and beyond: a systematic review," *The Lancet Digital Health*, vol. 3, no. 12, pp. e819–e829, 2021. [Online]. Available: https://doi.org/10.1016/S2589-7500(21)00210-7

[8] M. Adil and M. K. Khan, "Emerging IoT Applications in Sustainable Smart Cities for COVID-19: Network Security and Data Preservation Challenges with Future Directions," *Sustainable Cities and Society*, vol. 75, pp. 1–12, 2021. [Online]. Available: https://doi.org/10.1016/j.scs.2021.103311

[9] K. Intawong, D. Olson, and S. Chariyalertsak, "Application technology to fight the COVID-19 pandemic: Lessons learned in Thailand," *Biochemical and Biophysical Research Communications*,

vol. 538, pp. 231–237, 2021. [Online]. Available: https://doi.org/10.1016/j.bbrc.2021.01.093

[10] N. Morando, M. Sanfilippo, F. Herrero, M. Iturburu, A. Torti, D. Gutson, M. A. Pando, and R. D. Rabinovich, "Evaluación de intervenciones durante la pandemia COVID-19: desarrollo de un modelo basado en subpoblaciones con distintas tasas de contacto," *Revista Argentina de Microbiología*, 2021. [Online]. Available: https://doi.org/10.1016/j.ram.2021.04.004

[11] D. K. Chu, E. A. Akl, S. Duda, K. Solo, S. Yaacoub, H. J. Schunemann, D. K. Chu, E. A. Akl, A. El-harakeh, A. Bognanni, T. Lotfi, M. Loeb, A. Hajizadeh, A. Bak, A. Izcovich, C. A. Cuello-Garcia, C. Chen, D. J. Harris, E. Borowiack, F. Chamseddine, F. Schnemann, G. P. Morgano, G. E. U. Muti Schunemann, G. Chen, H. Zhao, I. Neumann, J. Chan, J. Khabsa, L. Hneiny, L. Harrison, M. Smith, N. Rizk, P. Giorgi Rossi, P. AbiHanna, R. Elkhoury, R. Stalteri, T. Baldeh, T. Piggott, Y. Zhang, Z. Saad, A. Khamis, M. Reinap, S. Duda, K. Solo, S. Yaacoub, and H. J. Schunemann, "Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis," *The Lancet*, vol. 395, no. 10242, pp. 1973–1987. [Online]. Available: https://doi.org/10.1016/S0140-6736(20)31142-9

[12] B. R. Rowe, A. Canosa, J. M. Drouffe, and J. B. A. Mitchell, "Simple quantitative assessment of the outdoor versus indoor airborne transmission of viruses and COVID-19," *Environmental Research*, vol. 198, p. 111189, 2021. [Online]. Available: https://doi.org/10.1016/j.envres.2021.111189

[13] F. Zhang, J. Zu, M. Hu, D. Zhu, Y. Kang, S. Gao, Y. Zhang, and Z. Huang, "Uncovering inconspicuous places using social media check-ins and street view images," *Computers, Environment and Urban Systems*, vol. 81, p. 101478, 2020. [Online]. Available: https://doi.org/10.1016/j.compenvurbsys.2020.101478

[14] M. Subiza-Pérez, T. Pasanen, E. Ratcliffe, K. Lee, A. Bornioli, J. de Bloom, and K. Korpela, "Exploring psychological restoration in favorite indoor and outdoor urban places using a top-down perspective," *Journal of Environmental Psychology*, vol. 78, p. 101706, 2021. [Online]. Available: https://doi.org/10.1016/j.jenvp.2021.101706

[15] D. Belanche, L. V. Casaló, and M. A. Rubio, "Local place identity: A comparison between residents of rural and urban communities," *Journal of Rural Studies*, vol. 82, pp. 242–252, 2021. [Online]. Available: https://doi.org/10.1016/j.jrurstud.2021.01.003

[16] L. Pan, J. Wang, X. Wang, J. S. Ji, D. Ye, J. Shen, L. Li, H. Liu, L. Zhang, X. Shi, and L. Wang, "Prevention and control of coronavirus disease 2019 (COVID-19) in public places," *Environmental Pollution*, vol. 292, p. 118273, 2022. [Online]. Available: https://doi.org/10.1016/j.envpol.2021.118273

[17] M. Hills, P. Klint, and J. J. Vinju, "Enabling PHP software engineering research in Rascal," *Science of Computer Programming*, vol. 134, pp. 37–46, 2017. [Online]. Available: https://doi.org/10.1016/j.scico.2016.05.003

[18] K. Alrashedy, D. Dharmaretnam, D. M. German, V. Srinivasan, and T. Aaron Gulliver, "Scc++: Predicting the programming language of questions and snippets of stack overflow," *Journal of Systems and Software*, vol. 162, p. 110505, 2020. [Online]. Available: https://doi.org/10.1016/j.jss.2019.110505

[19] O. D. Castrillón, W. Sarache, and S. Ruiz, "Desempeño de técnicas tradicionales de programación de la producción frente a un algoritmo evolutivo," *Información tecnológica*, vol. 29, pp. 141–154, 2018. [Online]. Available: http://dx.doi.org/10.4067/S0718-07642018000200141

[20] W. Auccahuasi, G. Bernardo, M. Bernardo, D. Vega, R. Urbano, and E. Oré, "Herramienta interactiva en línea como instrumento para el aprendizaje de las matemáticas mediante las técnicas de programación, dirigido a alumnos de educación secundaria," in *16th LACCEI International Multi-Conference for Engineering, Education, and Technology: Innovation in Education and Inclusion*, 2018, pp. 19–21. [Online]. Available: https://doi.org/10.18687/LACCEI2018.1.1.573

[21] L. Gómez-López, B. Tena-Blanco, R. Bergé-Ramos, M. Coca-Martínez, C. Forero-Cortés, and C. Gomar-Sancho, "Nueva plantilla para diseñar escenarios de simulación: interrelación de elementos en un vistazo," *Educación Médica*, vol. 19, pp. 350–359, 2018. [Online]. Available: https://doi.org/10.1016/j.edumed.2017.12.001

[22] M. L. Alfonso-Mora, A. L. Castellanos-Garrido, A. del Pilar Villarraga Nieto, M. L. Acosta-Otálora, C. Sandoval-Cuellar, R. del Pilar Castellanos-Vega, R. L. Goyeneche-Ortegón, and E. A. Cobo-Mejía, "Aprendizaje basado en simulación: estrategia pedagógica en fisioterapia. revisión integrativa," *Educación Médica*, vol. 21, no. 6, pp. 357–363, 2020. [Online]. Available: https://doi.org/10.1016/j.edumed.2018.11.001