Portuguese Language Journal | ISSN 1942-0986 |v. 16 (2022)
American Organization of Teachers of Portuguese

PORTUGUESE AS AN ADDITIONAL LANGUAGE AND CYBERSECURITY: A PILOT COURSE

DOI: 10.56515/PLJ562476673

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Abstract: This article describes the asynchronous module of the 2021 pilot course of Portuguese as an Additional Language (PAL) and cybersecurity offered through the Language Learning Center at the University of Washington and funded by the U.S. GenCyber grant. This grant is offered through the U.S. National Science Foundation (NSF) and the U.S. National Security Agency (NSA). The 2021 Portuguese GenCyber course was offered online in a summer camp format to two groups of high school students: Portuguese and Spanish speakers (either Heritage or Second Language Speakers). Our intention is to demonstrate the significance of the field of language for specific purposes (LSP) in relation to cybersecurity and particularly the importance of Portuguese in this field. We explain in detail the organization of the asynchronous module of the pilot GenCyber course and its differentiated tasks, which comprised approximately 20 hours of students' coursework completed in 3 weeks. The asynchronous module presented here could be replicated and/or adapted to other Portuguese courses as well. We finish the article with some of the results of the evaluation of the GenCyber program and some of the conclusions from the site visit to the program. This Portuguese GenCyber course is also a reminder of the possible role of Humanities in the development of special topic courses in languages, embracing the diversity of our student populations and the potential to apply their language skills to professional careers in high demand, as in the case of cybersecurity.

Keywords: Portuguese as an Additional Language (PAL), cybersecurity, Heritage speakers of Spanish and Portuguese.

Resumo: Este artigo descreve o módulo assíncrono do curso piloto de 2021 de Português como Língua Adicional (PAL) e segurança cibernética, oferecido pelo Language Learning Center da Universidade de Washington e financiado pela bolsa U.S. GenCyber. Esta bolsa é oferecida através da Fundação Nacional de Ciência dos EUA (NSF) e da Agência de Segurança Nacional dos EUA (NSA). O curso de português GenCyber de 2021 foi oferecido online em formato de acampamento de verão para dois grupos de alunos do ensino médio: falantes de português e falantes de espanhol (falantes de herança e de segunda língua). Nossa intenção é de demonstrar a importância do campo

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da linguagem para fins específicos (LSP) em relação à segurança cibernética e particularmente à importância do português nesse campo. Apresentamos detalhadamente a organização do módulo assíncrono do curso e as tarefas diferenciadas, que compreendiam aproximadamente 20 horas de trabalho para os alunos durante 3 semanas. O módulo assíncrono apresentado aqui também pode ser replicado e/ou adaptado para outros cursos de português. Finalizamos o artigo com alguns dos resultados da avaliação do programa GenCyber e algumas das conclusões da visita de especialistas no programa. Este curso de português e cibersegurança também nos lembra do possível papel das Humanidades no desenvolvimento de cursos de idiomas com uma temática especial, abrangendo a diversidade de nossa população estudantil e o potencial de aplicar suas habilidades linguísticas em carreiras profissionais de alta demanda, como no caso da segurança cibernética.

Palavras-chave: Português como Língua Adicional (PLA), cibersegurança, falantes de herança de espanhol e português.

1. Introdução

This article describes in detail the formulation of an asynchronous Portuguese course focusing on the principles of cybersecurity and possible careers in this field. This initiative was funded by the U.S. GenCyber grant[3], which is supported by the U.S. National Science Foundation (NSF) and the U.S. National Security Agency (NSA). In addition, the program counted on the support from the Center for Global Studies (CGS) at the University of Washington. It was the first time, to our knowledge, that the GenCyber grant was given to a cybersecurity course in a language other than English. In its pilot version, the GenCyber Portuguese program was offered through the Language Learning Center at the University of Washington as a summer camp in 2021 to high school students who were speakers of Portuguese and/or Spanish. Our goal with this article is to demonstrate how the asynchronous portion of the course was organized and thus, give the possibility for others to replicate or adapt it to their needs. We also provide a summary of the evaluation of the asynchronous program, which was conducted by a cybersecurity company, hired by the U.S. Government. Given the complexity of the GenCyber Portuguese course and the fact that most language instructors may not be familiarized with it, we decided to focus this article on the asynchronous portion of the course and leave the synchronous program and other aspects of the course for future studies. Below, we provide a contextualization of the cybersecurity field, its interdisciplinary nature, the high job demand, and the need for professionals with advanced skills in additional languages. We also discuss the field of language for specific purposes and the concept of translanguaging.

According to the World Bank, the world percentage of individuals using the internet has risen to 60% since the early years of the World Wide Web (1990s). In the Americas, Brazil stands among the countries where more than 79% of its population access the internet on devices ranging from computers, mobile phones, personal digital assistants, and other technological tools[4]. The developmental impact brought by the broadening access to information and communications technology goes beyond the scope of our present work. Nonetheless, it serves as a starting point to understand that the increasing reliance on the internet for growth in several development areas, namely economic, social, and cultural, also brings cybersecurity issues and concerns to the forefront of government policy of nations worldwide. As a noteworthy example of this, the National Cyber Strategy, launched by the White House in 2018, establishes that the U.S. Federal Government plays

[3] Visit the U.S. GenCyber site for more information on how to apply to their grants: https://www.gen-cyber.com/
[4] https://data.worldbank.org/indicator/IT.NET.USER.ZS?view=map

an active role in ensuring a secure and improved cyber environment for both the government and private sectors as well as individuals. The President's Budget for the Fiscal Year (FY) of 2020 included a 5% increase in "budget authority for cybersecurity-related activities" compared to the estimate in FY2019 (govinfo.org). With a submission of $9.6 billion in FY2020, the Department of Defense ranked as the largest contributor to the budget authority for cybersecurity-related activities, thus putting pressure on the U.S. military's effectiveness to train individuals in cybersecurity skills.

In their study, Daugherty and Li (2015) highlight the role of critical languages other than English as an all-important skill in maintaining mission effectiveness for both defensive and offensive cybersecurity operations. Among their findings from interviews with experts in cyber and language was:

> "Several of the experts interviewed commented that the U.S. education system does not produce enough individuals with language expertise. They expressed the view that beginning language training at age 18, when individuals are past the optimal age for second-language learning, is too late and thus not the best approach. A number of experts expressed strong views that language education should start earlier, in K–12 education, similarly to the numerous initiatives currently in place with science, technology, engineering, and mathematics (STEM) education" (p. 31).

While Portuguese Studies are offered in most larger universities in the United States, the teaching of Portuguese for specific purposes or Portuguese for the professions tends to focus on the areas of business, health care, interpretation. For instance, Kelm (2002), Kelm and Risner (2007), Viana da Silva (2020), and Pio (2022) have developed pedagogical materials for the teaching of Portuguese for business purposes. In addition, a few institutions of higher education offer business Portuguese courses in the United States, among them: University of Pennsylvania, Brigham Young University, and University of Florida. On the other hand, we are not aware of Portuguese language courses focused on the field of cybersecurity in the United States.

In a 2017 study about Language for Specific Purposes (LSP), business and culture top the list among the main areas of focus for LSP, followed by translation, academic purposes, service learning/community engagement, and health care (Sánchez-López, Long, and Lafford). Notably, cybersecurity has not been mentioned among the areas of interest with participants in this specific study. According to Long (2017), LSP in languages other than English started its foundation with the American Institute for Foreign Trade in 1946, when this institute created an integrated curriculum, which included business content and regional/cultural studies. Long (2017) explains that courses in LSP need the collaboration of practitioners and researchers from a variety of theoretical and applied disciplines, including theoretical linguistics, experiential learning, literary and cultural studies, and all the professional domains (p. 2).

LSP courses are developed within the following elements in mind:

(1) the student level of communicative competence,
(2) the urgency to use the language in professional context,
(3) the specific characteristics of such context, and
(4) the design of a program that promotes the learning process (Sánchez-López, 2023).

The development of the course in Portuguese and cybersecurity described in this article was designed according to the elements mentioned above, considering the multilingual background of students (speakers of English, Portuguese, and/or Spanish), and the high demand for professionals in cybersecurity, including those who come from diverse language and cultural backgrounds. Given this scenario, there was the need for an educational approach that would take advantage of the students'

strengths and for that reason we decided to follow the pedagogical framework of translanguaging into the UW course, allowing students to use their language skills while learning the target language. MacSwan (2022) explains that translanguaging is multifaceted, promoting a positive view of bilingualism and "permitting bilinguals to act naturally, using language as they might at home and in their communities" (p. 1).

Although the Portuguese GenCyber Program focused on the use of Portuguese during class activities and projects, students also used Spanish and English in order to help each other during class projects. In addition, we used both English and Portuguese in the design of the course, sometimes by introducing cybersecurity principles in English, for example, and other times by using English and/or Spanish to support students through glossaries and short explanations at times. Ofelia García (2009) has argued that translanguaging is a way for bilinguals to engage in educational practices and make sense of their bilingual worlds:

> "For us, *translanguaging are multiple discursive practices* in which bilinguals engage in order to *make sense of their bilingual worlds*. Translanguaging therefore goes beyond what has been termed code-switching […], although it includes it, as well as other kinds of bilingual language use and bilingual contact" (p. 45).

Nonetheless, we understand the focus that is given to the use of the target language in Portuguese language classes in the United States and in other places as well. Although we agree with the focus on the target language, we also believe that there is a space for the use of other languages. We believe that in the case of the Portuguese GenCyber course described here, translanguaging was the ideal approach, providing students with the language, cultural, and emotional support needed in a multilingual classroom. Many of the participants in the Portuguese GenCyber Program were heritage speakers of Portuguese and/or Spanish. In addition, most of the Spanish speakers in the course were learning Portuguese for the first time.

Designated as a critical language by the U.S. Department of State, Portuguese has more than 265 million speakers in the world. As such, according to the UNESCO, it is "a major language of international communication and a language with a strong geographical projection, destined to increase" (All Language Programs, U.S. Department of State). Alongside the leaning towards a greater relevance of Portuguese as a global language, a wider definition for the term cybersecurity has been articulated to include non-technical disciplines. In an effort to encapsulate the array and complexity of problems that cybersecurity confronts, Craigen, Diakun-Thibault and Purse (2014) proposed a new definition: "Cybersecurity is the organization and collection of resources, processes, and structures used to protect cyberspace and cyberspace-enabled systems from occurrences that misalign de jure from de facto property rights" (p. 17).

A broader definition calls for a multidisciplinary approach to cybersecurity training, as one of the former directors of research for the NSA, Frederick Chung (2015), explains:

> "Technology by itself cannot solve the problem because we are dealing with a human adversary and a human victim behind a computer [...]. We must approach the issue from an interdisciplinary perspective – one that includes specialists from computer science, cognitive science, economics, mathematics, political science, business and more" (p. 1).

Co-funded by the NSA and NSF, the GenCyber Program was established in 2014 to increase interest in cybersecurity careers among K-12 students as well as diversity in the workforce. To accomplish so, students and teachers attend free summer camps, currently offered in 44 U.S. states,

besides the District of Columbia and Puerto Rico. The program was originally modeled after STARTALK[5], another NSA-supported program created to increase the number of students enrolled in studying critical languages.

In addition to the GenCyber programs, other federal agencies support the teaching and careers in the GenCyber field in the U.S. The National Initiative for Cybersecurity Education (NICE)[6] provides a publication, the NICE Framework, which acts as a reference resource for describing and identifying the knowledge, skills, and abilities for professionals to complete cybersecurity tasks that effectively improve their organization's cybersecurity posture. Among the seven categories described in the Framework as in Table 1 below, the Analyze (AN) category manifests the need for professionals with additional language skills.

Table 1 - NICE Framework Workforce Categories

Categories	Descriptions
Securely Provision (SP)	Conceptualizes, designs, procures, and/or builds secure information technology (IT) systems, with responsibility for aspects of system and/or network development.
Operate and Maintain (OM)	Provides the support, administration, and maintenance necessary to ensure effective and efficient information technology (IT) system performance and security.
Oversee and Govern (OV)	Provides leadership, management, direction, or development and advocacy so the organization may effectively conduct cybersecurity work.
Protect and Defend (PR)	Identifies, analyzes, and mitigates threats to internal information technology (IT) systems and/or networks.
Analyze (AN)	Performs highly-specialized review and evaluation of incoming cybersecurity information to determine its usefulness for intelligence.
Collect and Operate (CO)	Provides specialized denial and deception operations and collection of cybersecurity information that may be used to develop intelligence.
Investigate (IN)	Investigates cybersecurity events or crimes related to information technology (IT) systems, networks, and digital evidence.

Table 1: NICE Framework Workforce Categories

Aligned with the National Centers of Academic Excellence in Cybersecurity (NCAE-C) program, the GenCyber programs seek to provide knowledge about future career opportunities for K-12 students across the nation.

Offered in July and August 2021 as a pilot program, the UW GenCyber Summer Camp sought to increase student diversity in cybersecurity training by hosting the camp mainly in Portuguese and offering it to heritage and second language speakers of both Portuguese and Spanish. With its long-held and demonstrated expertise in teaching foreign languages, UW relied on the success of its previous 2017 STARTALK summer camp Portuguese STEM Program[7], also offered to high school students, speakers of Portuguese and/or Spanish.

2. Course Overview

[5] STARTALK is a language program funded by the U.S. Department of Education. The STARTALK Programs are dedicated to critical languages and focus on several areas of knowledge through summer programs for K-12 students. The University of Washington has been offering STARTALK courses for the past 9 years, focusing on Russian and STEM. In 2017, UW offered a STARTALK Program in Portuguese and STEM for high school students. Visit the following link for more information: https://depts.washington.edu/startalk/student.php

[6] For more information on the National Initiative for Cybersecurity Education (NICE), visit the link: https://niccs.cisa.gov

[7] Visit this site for more information on the 2017 STARTALK summer camp Portuguese STEM Program: https://depts.washington.edu/startalk/student_portuguese_stem_2017.php

The acronym GenCyber stands for the next **Gen**eration of **Cyber**stars and as such, according to their sponsors (NSA/NSF), the learning opportunities at the Gencyber Program include: advancing cybersecurity concepts, ethics, cybersecurity careers, and online safety at the K-12 level. At no cost to participants, the 2021 UW GenCyber Summer Camp[8] was offered as a two-module program (please see Image 1 below): Program A (asynchronous) and Program B (asynchronous and synchronous). In order to ensure eligibility, students needed to provide proof of U.S. high school enrollment and speak Portuguese and/or Spanish at the intermediate-mid or higher level of proficiency.

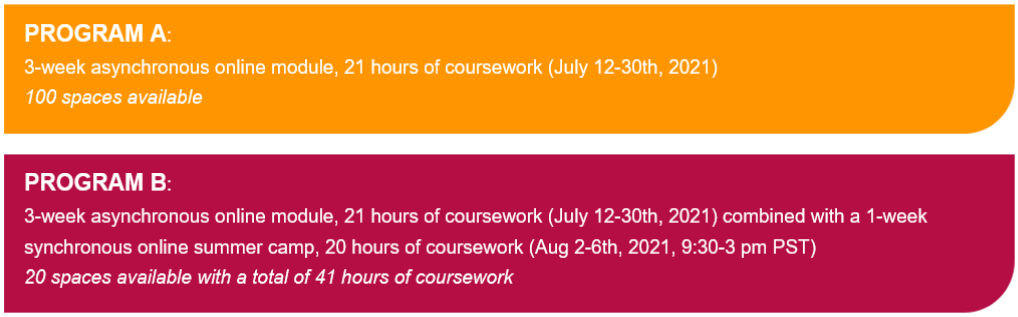


Image 1: GenCyber Program A and Program B

GenCyber program participants who were able to complete **Program A,** received a certificate of completion in "Essentials from Cybersecurity and Portuguese" for 21 hours of coursework from the UW Center for Information Assurance and Cybersecurity (CIAC) and the UW Language Learning Center (LLC). Those who successfully completed **Program B** received a certificate for 41 hours of coursework from UW CIAC and LLC, including 20 hours of class and group work during real time online. Some students were also able to earn the Washington State Seal of Biliteracy[9] for Portuguese.

Participants also explored the National Initiative for Cybersecurity (NICE), Cybersecurity Workforce Framework and resources, such as Cyberseek.org. These resources introduced students to the incredible demand and opportunities offered in cybersecurity, as well as the diversity of sub-disciplines they might pursue. The 'Essentials of Cybersecurity' series ends with a module on 'Finding Your Cybersecurity Career Path' and then helps students construct their 'Job Outlook'.

There were indeed many moving parts to this course in order to prepare and promote interactions with learners during the asynchronous course. The chart below (Table 2) helps to visualize how the asynchronous modules were organized by providing an overview of the course.

Structure of the Moodle platform	**Spanish-Speaking Students**	**Portuguese-Speaking Students**
Introductional Module	• Announcement tabs • Course objectives • Pre-course Survey tab • Informational video on the Global Seal of Biliteracy	• Announcement tabs • Course objectives • Pre-course Survey tab • Informational video on the Global Seal of Biliteracy

[8] For more information about the UW GenCyber Summer Program visit the site: https://depts.washington.edu/gencyber/
[9] For more information about the requirements for the Global Seal of Biliteracy, visit the site: https://theglobalseal.com/

Week 1 Module	19 exercises in total: ● 2 discussion boards ● 4 podcasts ● 3 short videos ● 1 long video ● 7 reading assignments ● 1 grammar lesson ● 1 voice recording exercise	16 exercises in total: ● 3 discussion boards ● 3 podcasts ● 3 short videos (1 as part of the discussion board) ● 1 long video ● 7 reading assignments with open answers
Week 2 Module	23 exercises in total: ● 2 discussion boards ● 4 podcasts ● 7 short videos ● 1 long video ● 8 reading assignments ● 1 grammar lesson	22 exercises in total: ● 2 discussion boards ● 3 podcasts ● 8 short videos ● 1 long video ● 8 reading assignments with open answers
Week 3 Module	21 exercises in total: ● 3 discussion boards ● 5 podcasts ● 6 short videos ● 1 long video ● 4 reading assignments ● 1 grammar lesson ● 1 voice recording exercise	16 exercises in total: ● 2 discussion boards ● 2 podcasts ● 7 short videos ● 1 long video ● 4 reading assignments with open answers
Additional Resources Module	● 3 recorded mini-lessons ● 2 presentations with cybersecurity professionals ● 5 cybersecurity resources online	● 3 recorded mini-lessons ● 2 presentations with cybersecurity professionals ● 5 cybersecurity resources online

Table 2: Overview of the Portuguese GenCyber asynchronous course

We believe the asynchronous portion of this course was fundamental to providing students with an introductory knowledge of cybersecurity principles and some of the terminology, considering that most students did not have much previous knowledge on cybersecurity prior to the beginning of the Portuguese GenCyber course. It also informed students about possible career paths in cybersecurity. The content introduced in the asynchronous course was then revisited in the synchronous one, which focused mostly on projects for small group work (each group of four students was assisted by one Portuguese instructor). We will further discuss the organization of the asynchronous course after describing the course participants.

3. Description of participants

Participants in the GenCyber Program were speakers of Portuguese and of Spanish as heritage and/or second language with a solid command of their respective languages at the intermediate-mid level of proficiency or higher. In addition, the course aimed at enrolling female and minority group students, including daughters/sons of immigrants and students of color. In order to achieve this, the course promotion was done extensively, reaching out to students in both urban and rural areas as well as those who do not have the opportunity to take a Portuguese language course in their U.S. region. In the GenCyber proposal for the course grant, we stated the following under target participation:

> "Recruitment will target heritage Portuguese or Spanish speaking students, especially those from underrepresented groups in the cybersecurity field, including female students, students of color, and students in agricultural or rural areas with less access to these types of courses and mentorship opportunities. We expect that the online program will attract students from several areas of the United States, especially those with a large immigrant population of Portuguese and Spanish-speakers" (GenCyber 2021 Proposal).

In fact, we were able to attract students from diverse regions of the United States, including the following states (in alphabetical order): Arkansas, California, Georgia, Hawaii, Illinois, Maryland, Massachusetts, North Carolina, Texas, Utah, Virginia, and Washington.

The table below (Table 3) shows the breakdown of students by language background and gender identification.

STUDENTS (N=25)	**Heritage Speakers of Portuguese**	**Heritage Speakers of Spanish**
Female Students	7	1
Male Students	6	3
Non-binary Students	None	None
	Second Language Speakers of Portuguese	**Second Language Speakers of Spanish**
Female Students	1	1
Male Students	4	2
Non-binary Students	None	None

Table 3: Students Background - GenCyber Asynchronous Program

As for the group racial and ethnic diversity, out of the 13 Portuguese heritage speakers, 12 have Brazilian heritage and one has Portuguese heritage. Other four students have Spanish heritage, three from Mexico and one from Panama. From the 25 enrolled in the asynchronous program, one is Pacific Islander, one is from Africa, one is African-American, two are Asians, four are Latinos/Latinas, eight are Caucasians, and eight are mixed-raced from Brazil.

Regarding the completion rate of the asynchronous program, out of the 25 participants, 21 have completed the asynchronous course and received a certificate of completion, while four students were able to complete less than 73% of the course and for that reason have not received a certificate. The completion rate was 84%.

4. Organization of the asynchronous course

The asynchronous course consisted of three weeks of online activities through the open-source learning platform Moodle, hosted at the Language Learning Center (LLC) at the University of Washington. Students received the log-in information (username and password) by email in order to access the course. We estimated approximately seven hours of course work per week for students to complete their assignments, with a total of 21 hours for the three week-course. The time spent on the completion of activities varied according to the proficiency level of students in Portuguese and/or Spanish and their dedication to the summer camp. In order to keep students on task and at a regular

pace, we established deadlines for some activities in the middle of each week, on Wednesdays, and for the remainder, the target date was at the end of each week, on Sundays. The asynchronous course aimed at introducing students to the principles of cybersecurity and some basic concepts. Below are the goals of the asynchronous course as stated in the Moodle platform in Portuguese and English (We are just providing the English text here):

> In this first module, we will begin our journey through the principles of Cybersecurity. As you broaden your Portuguese Language skills, you will also learn how to:
>
> - Define key terms and concepts in the field of cybersecurity
> - Identify and distinguish threat actors and their motivations
> - Match appropriate types of controls to the actions of different threat actors
> - Describe the differences and interactions among international agencies related to cybersecurity
> - Describe at least two potential legal challenges to cybersecurity in the United State and learn about potential career paths in cybersecurity

The online modules on the Moodle platform were divided into separate weeks (*Semana 1, Semana 2, Semana 3*) and with a section for additional resources (*Recursos Adicionais*). We introduced the course in Portuguese and listed some key information on the top of the Moodle page: Announcements, Course Objectives, Pre-Course Survey, Office Hours, and Global Seal of Biliteracy. Below is the introduction page to the asynchronous course from the Moodle website:

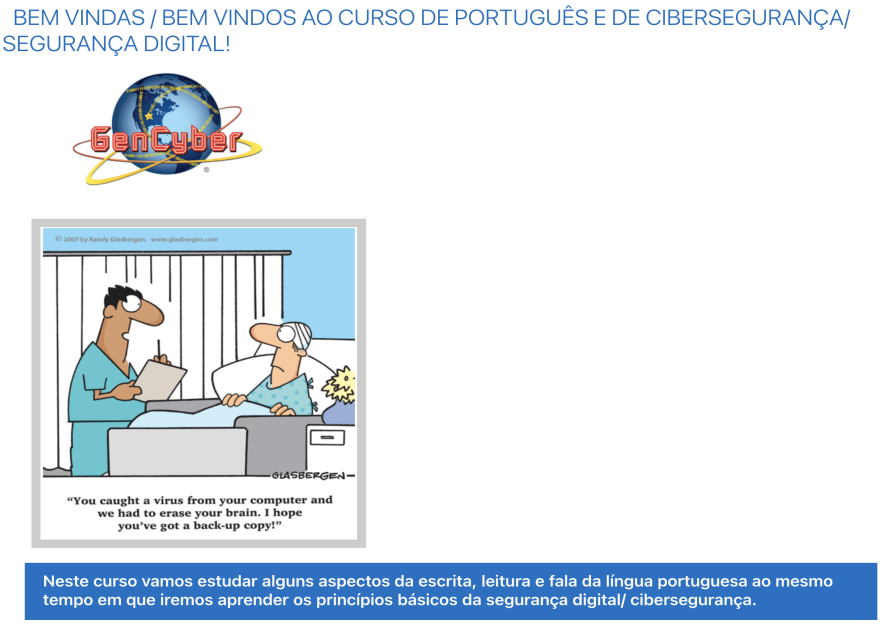


Image 2: Introduction to the Portuguese GenCyber asynchronous course on Moodle

The pre-course survey was particularly important, as we were interested in collecting data about the students' understanding of cybersecurity before they started engaging with the course material. The survey contained a series of questions ranging from what they have possibly learned previously on the subject to specific questions about cybersecurity concepts (e.g. encryption) and their knowledge of careers in the field (See Appendix 1).

Since the Portuguese GenCyber course was offered to both speakers of Portuguese and Spanish, we created an online course for each group adapting the Moodle activities to their needs. Nonetheless, the main selection of activities on cybersecurity contained the same set of cybersecurity principles, concepts, and information on career paths for both groups. For this reason, we opted to introduce some of the cybersecurity concepts in English through short videos and then present the same concepts again in Portuguese. In addition, we prioritized short videos and/or reading passages. The content for both GenCyber Portuguese asynchronous courses (for Portuguese speakers and for Spanish Speakers) was presented as follows:

- Safe behaviors online, the importance of data and cookies, types of cyber-attacks: malware, virus, phishing, exploit;
- CIA (Confidentiality, Integrity, and Availability), the history of the Internet and cybercrimes;
- Safe passwords, security controls, cryptography, cyber bullying;
- Social Engineering (frequency, threat actors, actor motives, compromised data);
- Nationals Institute of Standards and Technology (NIST), Careers in Cybersecurity;
- National Initiative for Cybersecurity Education (NICE);
- Cyber Seek - Career paths in cybersecurity.

In order to keep the content digestible to students, it was important to provide age appropriate activities and use scaffolding to break down the information in bits and pieces. Among the ways to achieve this was using short readings in Portuguese (sometimes written specifically for this course) and also short videos with animation and visuals. There are several resources available online with brief introductions to cybersecurity for young students (teenagers) introducing major cybersecurity concepts. We mainly used the following:

- Introductory videos on cybersecurity from PBS NOVA Labs (in English only) and Khan Academy (Available both in Portuguese and English)
- Short texts on the history of the internet and cybersecurity from Khan Academy and Britannica Escola (Available in Portuguese and English)
- Documentaries in Portuguese from the show *Expresso Futuro* (Recorded in the United States, this Brazilian tv show is intended for a Brazilian audience and presents many conversations/discussions with specialists both in Portuguese and in English with Portuguese subtitles)
- Videos and texts from BBC News Brasil (in Portuguese)
- Bits N' Bytes - Cybersecurity educational activities developed by the 18-year-old cybersecurity expert, Kyla Guru, in addition to her TED Talk (both available in English only)
- The websites from NICE, NIST, and Cyber Seek (available in English only)

Image 3 below helps to visualize the use of animated videos introducing cybersecurity concepts.

Image 3: Video on cybersecurity from PBS NOVA Labs- Cybersecurity 101 (https://www.pbs.org/wgbh/nova/labs/lab/cyber/1/1/)

5. Differentiated tasks

The use of differentiated tasks was vital to the success of the Portuguese GenCyber course. In the Moodle modules for the Spanish speakers, the main focus was on comprehension of short written texts and videos on cybersecurity and on an introduction to beginner and intermediate-low level speaking activities (e.g. how to introduce yourself, ask simple questions, and talk about likes and dislikes). Having that in mind, we modified the asynchronous activities so that Spanish-speaking students would be able to complete them. This included the use of glossaries with Portuguese-English/Spanish and of subtitles in Portuguese and/or English in the course videos, among other strategies. We also relied on the introduction of new topics in English with comprehension questions in Portuguese.

If we take the example from the PBS NOVA Lab video (Cybersecurity 101), even though the video was in English, the comprehension questions for Spanish-speakers were presented in Portuguese as multiple choice with the translation of some key-words being provided, as in the example below (Image 4):

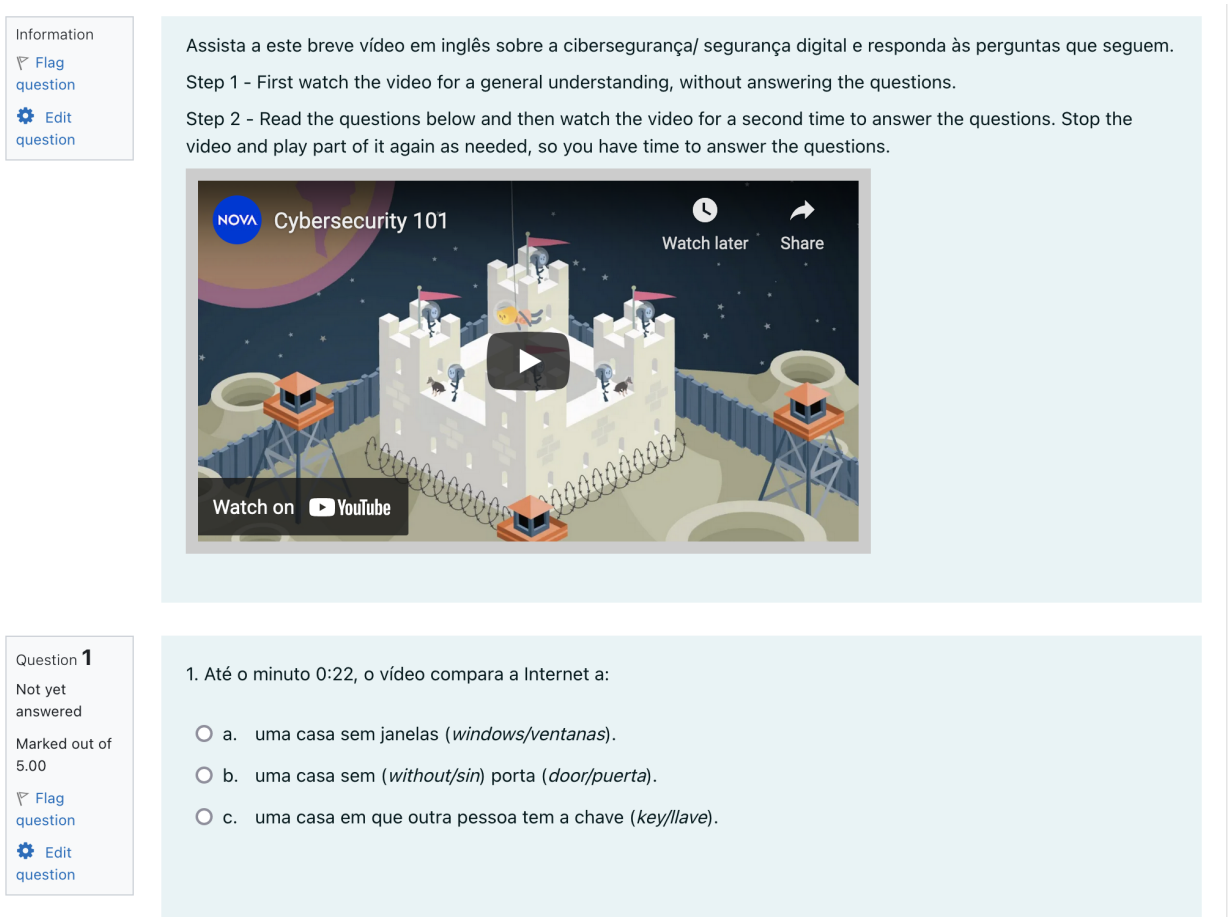


Image 4: Preview of Activity 1.14 (Vídeo PBS NOVA: Cybersecurity 101)
Moodle asynchronous course for Spanish Speakers, Week 1

As one can see in the example above, students are able to work with cognate words from Spanish (e.g. *casa, pessoa*) while the new vocabulary is being provided to them (e.g. *janelas* - windows/*ventanas*). Since the video is in English, oral comprehension is not an issue. The decision to use multiple languages is also based on the translanguaging approach described in the introduction of this article.

In the course for Portuguese speakers, the main focus was on the comprehension of longer written and oral texts on cybersecurity and the production of written texts in Portuguese at the advanced and superior level (e.g. talk about past activities and write a summary of a documentary about cybersecurity in Portuguese). In the example of the PBS NOVA video (Cybersecurity 101), the comprehension exercise for Portuguese speakers included an open-ended question, so students could write a summary of the English video in Portuguese, as shown below in Image 5.

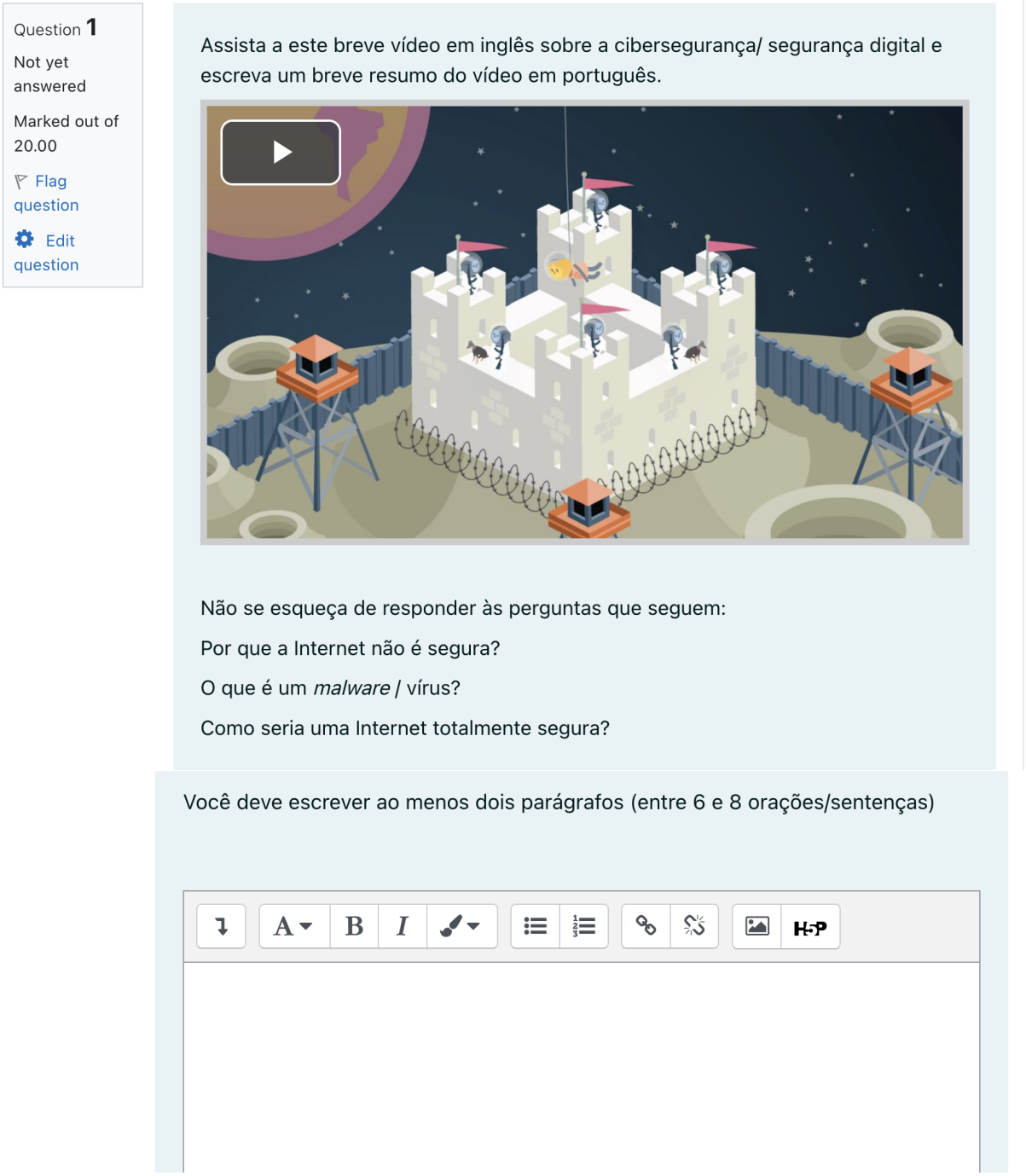
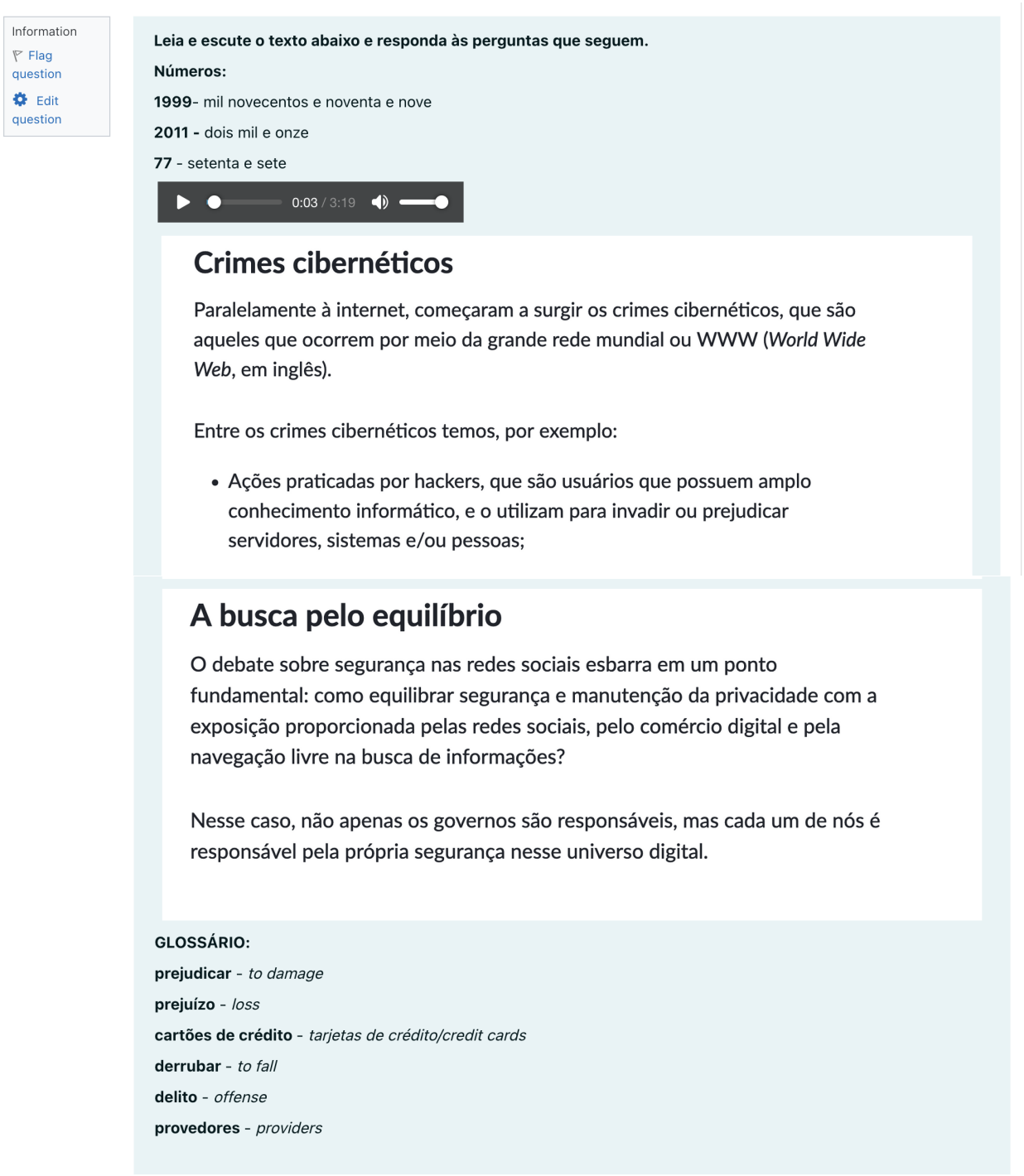


Image 5: Preview of Activity 1.11 (Vídeo PBS NOVA: Cybersecurity 101)
Moodle asynchronous course for Portuguese Speakers, Week 1

After introducing some of the new topics in English, the following videos and reading assignments would be presented in Portuguese. For the Portuguese speakers the focus of the exercises remained on improving their writing skills, while for the Spanish speakers the focus was on comprehension of exercises (multiple-choices and matching exercises). All reading assignments were voice recorded by the Portuguese instructors, so students could listen to the pronunciation of the texts. Readings were also accompanied by a glossary, which was expanded for the modules for

Spanish-speakers, considering false-cognates between Spanish and Portuguese and also supplying a glossary for keywords. The example below comes from a reading assignment about cybercrimes from Khan Academy. Image 6 shows the use of the elements mentioned previously, focusing on Spanish speakers learning Portuguese.



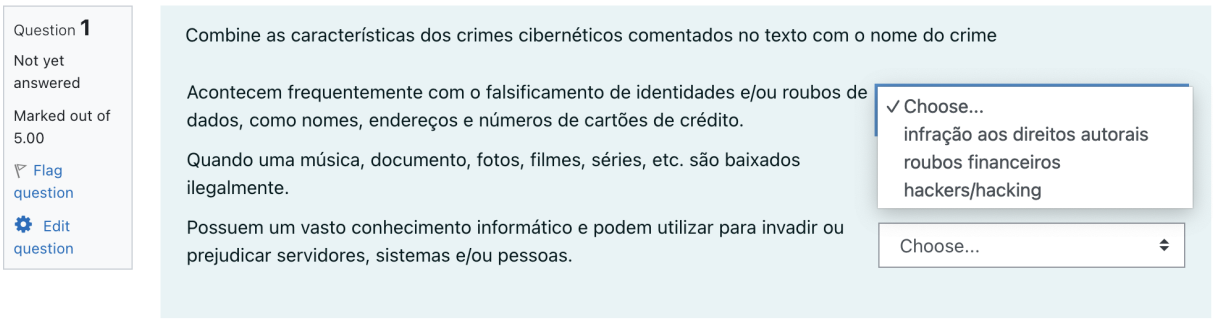


Image 6: Preview of Activity 2.3 (Khan Academy: Crimes Cibernéticos)
Moodle asynchronous course for Spanish Speakers, Week 2

The reading assignment above was cut short for the purpose of demonstration only. We always presented numbers in full writing (e.g. 2011 - *dois mil e onze*) and included vocabulary in the glossary that could cause confusion with English and/or Spanish speakers (e.g. *prejudicar* - to damage). As we prepared the activities, we tried to anticipate the difficulties that both Spanish speakers and Portuguese speakers might encounter.

The asynchronous section of the course was also an opportunity for students to start interacting with each other through the discussion boards built-in on Moodle. One of the initial activities in Week 1, for instance, was about personal information that students would never share with strangers on the street. Students were asked to provide their answers and to write a short comment to a colleague. The example below demonstrates how much assistance was needed for Spanish-speaking students to perform well in this task.

> Pense nos dados e nas **informações pessoais** (*personales*) que você JAMAIS compartilharia com um estranho na rua. Escreva uma lista de 4 ítens e depois faça um comentário para uma colega/ um colega.
> **CONSULT THE DICTIONARY WORD REFERENCE FOR ENGLISH-PORTUGUESE VOCABULARY. Do not use Google translation for whole sentences; instead, look word by word in the online dictionary.**
> **Exemplo:** Eu nunca compartilharia o meu nome completo, o meu…
> **Comentário para uma colega/um colega:** Legal! (*Cool!*) Eu não tinha pensado nisso, mas eu também não compartilharia essa informação!

We used discussion boards twice or three times per week in order to encourage interaction among students. Instructors also provided feedback to students on the Moodle platform. We also held office hours with the lead instructor and an additional instructor once a week. Given that students were in different time zones, attending office hours could be challenging for some, but we chose a time that would be accessible to most. The main goal was to invite students to communicate with us.

In addition to the discussion board and office hours, we conducted one mini-lesson per week for each cohort. The mini-lessons were designed to last between 15 and 20 minutes and to encourage students who might be available to participate and interact with instructors and other course participants in real time. We would then record the mini-lessons and post them on the Moodle platform for students to watch in their own time. The mini-lessons were also an opportunity for the Portuguese instructors and learners to interact in a class-format. The lead-instructor conducted the first mini-lesson in collaboration with another instructor and the other mini-lessons followed the same format: a short introduction of the point being taught, followed by time for practice with the students who were participating in breakout rooms on Zoom. We would then reconvene and go over answers and eventual questions. Each mini-lesson was co-conducted by two instructors. We offered the following titles/content by cohort:

- Portuguese-speaking cohort
    - Mini-lesson - Week 1: Acentuação
    - Mini-lesson - Week 2: Ligando Ideias e Conjunções
    - Mini-lesson - Week 3: Escrita em português

- Spanish-speaking cohort
    - Mini-lesson - Week 1: Saudações, Apresentações e Pronúncia em Português
    - Mini-lesson - Week 2: Gêneros e o Verbo Gostar
    - Mini-lesson - Week 3: Pronúncia em Português

The Portuguese mini-lessons focused on the production of Portuguese at the beginner and intermediate levels by contrasting and comparing it with Spanish (e.g. *Me gusta viajar/ Eu gosto de viajar*). In the mini-lessons for Portuguese speakers, the focus was on writing by giving examples of how to use accents in Portuguese and correctly connect words. We typically had a few students per lesson, between two and six, but their participation was key in creating the content for the rest of the class.

Other tasks that were tailored for each cohort involved pod-casts from the Center for Open Educational Resources (COERLL) at the University of Texas at Austin. We used the Brazil pod series in the course, where students had to listen to between three and five podcasts per week and answer questions on Moodle. For Spanish-speakers, we used a selection of podcasts from *Tá-Falado: Portuguese for Spanish Speakers* whereas for Portuguese-speakers, podcasts from *Língua da Gente*[10] were selected and used.

Another key component of the asynchronous course was the presentations by guest-speakers who were distinguished and experienced cybersecurity professionals. Students had the opportunity to interact and/or watch recorded and live presentations given by professionals in the cybersecurity field. The two guest-speakers invited to participate in the asynchronous course (Week 2 and Week 3) were not fluent in Portuguese so they presented in English. As not all students were able to participate during real-time, we recorded the presentations and made them available in the Moodle platform, just as we did with the mini-lessons. We also assigned the presentation from Week 2 as part of the homework for Week 3 in the asynchronous course. And finally, we revisited part of these presentations during the synchronous portion of the course.

6. Course evaluation

At the end of the GenCyber Program (asynchronous and synchronous programs), students answered a course evaluation survey conducted by the GenCyber grant. This survey followed the four-phase model of interest developed by Hidi and Renniger (2006) as seen in Image 7 below.

[10] For full access to the podcast Tá-Falado, visit the link: https://www.coerll.utexas.edu/brazilpod/tafalado/ and for access to the podcast Língua da Gente, visit the link: https://linguadagente.coerll.utexas.edu/

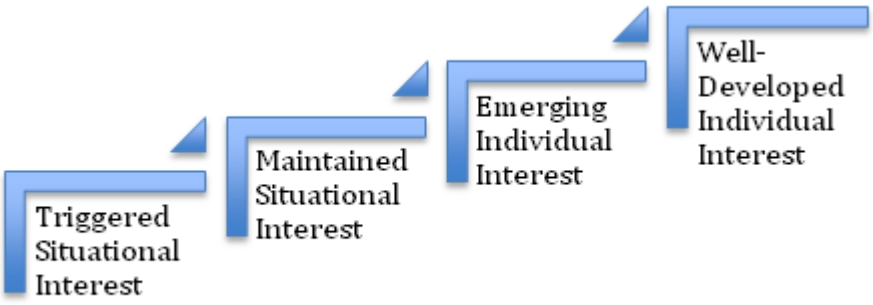
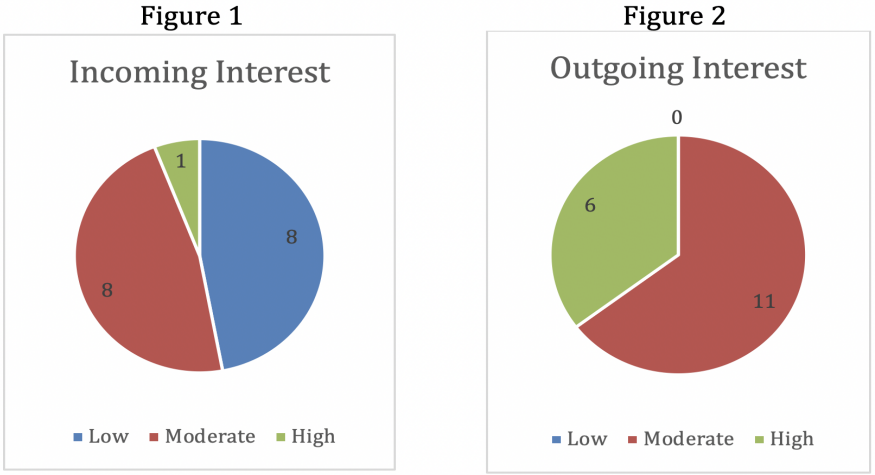


Image 7: The Four Phase Model of Interest by Hidi and Renniger (2006)

As individuals progressed through the four stages illustrated above, the two first-phases (triggered and maintained situational interests) were critical in the UW Portuguese GenCyber Program, particularly in activities that provided interaction among participants, as in the asynchronous discussion forums and activities with content which was relevant to the students' lives (e.g. cyberbullying and creating safe passwords).

The third phase (emerging individual interest) was mainly supported by the students' engagement with mentors and role-models as in the case of UW GenCyber guest-speakers who presented cybersecurity topics, especially the career-oriented ones. Furthermore, phase four (well-developed individual interest) is where interest in cybersecurity is mostly self-generated. The UW GenCyber program was successful in providing a learning environment that allowed challenge and interaction in supporting knowledge building. One of the cornerstones of phase four was the scaffolded cybersecurity and PAL curriculum, which provided opportunities for growth to students with diverse Portuguese language abilities and also, bolstered participants by encouraging them to research their areas of interest in the cybersecurity field.

The framework above (Four Phase Model of Interest) was used with the following goals: 1) identify and classify the incoming and outgoing interest levels of the attendees at this camp, as well as interest development, and 2) provide feedback on the interest development efficacy of this camp using seven constructs and open-ended items of enablers and barriers. The results of the survey demonstrated that students gained an interest in the field of cybersecurity at the end of the course, as seen below in Graph 1.



Graph 1 - Income and Outgoing Interest

For the 17 students who answered the final survey, Graph 1 above shows that the level of interest in the field of cybersecurity increased significantly after the four-week program (three weeks asynchronously and one week synchronously). If at the very start of the program, eight students out of 17 had low interest in cybersecurity, by the end of the Gencyber and Portuguese program the numbers shifted and none of the students chose the low interest option. Instead, 11 students identified their level of interest in the field as moderate at the end of the GenCyber program whereas the remaining six students had a high interest in cybersecurity, as opposed to only one participant with a high interest level at the beginning of the program.

The students' comments below exemplify the impact of the asynchronous program and its differentiated activities on their increased interest level in cybersecurity:

> "I liked learning about the different careers, specifically things like ethical hacking." (Student 1)
>
> "The videos during the asynchronous part of the camp were very engaging and gave me a better visual representation of certain cybersecurity actions such as encryption." (Student 2).
>
> "Professionals came and spoke with us. There was a lot of information displayed to both the students and instructors" (Student 3).
>
> "The guest speakers introduced me to careers regarding cybersecurity; they opened my eyes to the extent that there were more options than I thought. Learning about the new careers thus increased my cybersecurity interest." (Student 4)

As mentioned repeatedly in the students' comments above, learning about possible careers in cybersecurity from guest speakers was key to the success of the GenCyber program. Some students also highlighted the effectiveness of the videos and the importance of some topics, such as ethical hacking and encryption, among others.

As an integral part of GenCyber programs, the GenCyber site visit was conducted on the eighth day of the asynchronous program. When asked about the strengths of the program, the site visitors (two cybersecurity specialists with teaching experience), highlighted the following:

> "This UW camp intends to address the need to learn Portuguese as a critical language for the specific purpose of cybersecurity as recognized by the U.S. Department of Defense and the U.S. Department of Education. Staff at this camp have teamed up with the UW LLC and CIAC to provide a unique educational opportunity intersecting the areas of cybersecurity and language education in Portuguese in an effort to create interest in pursuing cybersecurity as a career while attending high school and in the subsequent years in college. Camp staff has worked diligently to adjust to an online platform delivered both asynchronously and synchronously and in both Spanish and Portuguese. This camp is providing a scaffolded cybersecurity curriculum based upon participant abilities, which is supplemented by guest speakers, presentations, hands-on activities and language lessons. Learning in this safe, supported environment should prove to increase interest in the field of cybersecurity for these participants." (Site Visit 2021)

In fact, the comments above very well summarize the intentions of the 2021 Portuguese GenCyber Program and the efforts of the language educators to achieve a supportive language learning environment for students with a certain range of language abilities in Portuguese and/or Spanish and different levels of previous knowledge in cybersecurity.

7. Conclusion

The 2021 Portuguese GenCyber Program was indeed a novel course and a substantial undertaking for both students and Portuguese language instructors involved. Given the complexity of the topic and the fact that the class was multilevel and interdisciplinary by nature, the use of differentiated tasks was fundamental to the course success. Also, the creation of highly engaging and age-appropriate activities was decisive in keeping students actively participating in the asynchronous portion of the program. In the case of the Spanish-speaking participants without previous exposure to Portuguese and the Portuguese-speaking students with intermediate-low language ability, this course was certainly a monumental challenge. Mainly because most of the language used in the course from readings and videos is at the advanced level, so students without previous knowledge of Portuguese or with a lower level of proficiency needed more guidance in order to be successful. Nonetheless, participants were able to complete the asynchronous activities with a high level of accuracy, in part because of the scaffolding used in the activities (use of glossaries, voice recordings, etc.) and because of the support from the translanguaging approach as well.

We were also pleased to see that the great majority of students completed more than 80% of the coursework in the asynchronous program (21 out of 25 students). The participation of guest-speakers, the inclusion of mini-lessons, and the discussion forums were the highlight activities of the asynchronous program, later serving as the cornerstone for the synchronous program. Although it was not thoroughly discussed in this article, the synchronous portion included a week of intensive online classes (20 hours in total), where we revisited cybersecurity principles, welcomed more guest-speakers from the field, and reexamined concepts through small group projects.

This course could be replicated in other educational settings as well, at the middle school, high school, or university levels. Depending on the type of schooling, the activities would have to be modified in order to be age-appropriate. Our course focused on teenagers and young adult populations and the types of activities developed reflect the students' age and interests as well. Our main suggestion for Portuguese instructors interested in replicating this course is the need to become familiarized with the field of cybersecurity months in advance of the course. We began preparing the course six months in advance of its starting date. In addition, we recommend that instructors take an introductory online course on cybersecurity[11] and start building a network of cybersecurity professionals, who might be invited as guests-speakers for the course and/or provide some additional support. As instructors get familiarized with the field of cybersecurity, we found important to involve the whole team in the creation of the Portuguese GenCyber course by assigning tasks based on their individual strengths. We also asked each instructor to test out the course and complete all asynchronous activities online.

Our main limitation in the development of the asynchronous portion of the course presented here was the fact that most Portuguese instructors involved in this project did not have much knowledge of cybersecurity principles. Therefore, the development of the first activities was challenging, as we had a steep learning curve ahead of us. Overall, the Portuguese instructors learned as the course was being developed and we were grateful to count on the support from some cybersecurity professionals and from one of the instructors who had previous knowledge of cybersecurity. Without their support, it would have been much more difficult to achieve a successful course.

8. Acknowledgments

[11] We recommend the course "Introduction to Cybersecurity for Teachers" from Future Learn, available at: https://www.futurelearn.com/courses/teaching-cybersecurity

We would like to thank the team from the UW Language Learning Center (LLC): Dr. Paul Aoki, Dr. Russell Hugo, and Kathryn Ong. We are also grateful to Tamara Leonard, former managing director from the Center for Global Studies (CGS) and Christian Lee Novetzke, former GCS director. Both centers, LLC and CGS at the University of Washington, were fundamental with the support and organization of the Portuguese GenCyber Summer Program. Also, a special thank you to our team of Portuguese instructors: Heloísa Machado, Anderson Sidles, and Júnia R. Benner for all their dedication, contributions, and enthusiasm. We need to thank the help from the guest speakers for the Portuguese GenCyber course as well and from Dr. Barbara Endicott-Popousky, executive director from the UW Center for Information Assurance and Cybersecurity, and Dr. Marc J. Dupuis, UW assistant professor from the Division of Computing and Software Systems. Finally, a big thank you to the pedagogical guidance from Dr. Michele Aoki. The UW Portuguese GenCyber Program was funded by the U.S. GenCyber grant from NSA and NSF.

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APPENDICES

Appendix 1 - Pre-Class Survey

- 1. When you think of "cybersecurity", what words come to mind?
- 2. In your opinion, which image below best matches your feelings about cybersecurity? Feel free to elaborate on why. (We presented a picture of a dog, a door with the key on, a map with magnifying glasses, and a magician).
- 3. When was the last time you read about cybersecurity in the news?
- 4. Choose the option with the words with which you are already completely familiar (i.e. you can easily explain what they mean)
    - malicious link and public WiFi
    - password safety and encryption
    - phishing attack and two-step authentication
    - password safety and double-factor authentication
- 5. Have you ever learned about cybersecurity at school?
    - Yes
    - No
- 6. Do you learn about cybersecurity on your own?
    - Yes
    - No
- 7. Do you often hear/read about cybersecurity in the news?
    - Yes

    - No
- 8. Are you considering cybersecurity as a career option?
    - Yes, I'm truly interested.
    - Yes, but I am not completely sure yet because I am considering other options as well.
    - No, but I might change my mind in the future.
    - No, because I already know my career option.
    - Other: _____
- 9. Which option contains a word associated with what the term encryption is truly about?
    - Typing
    - Sending
    - Assessing
    - Converting
    - Representing
    - Other: _____
- 10. Have you ever heard of phishing scams?
    - Yes
    - Vaguely
    - Not really
    - Never
- 11. When it comes to preventing a cyber attack on your school/personal devices, which options make most sense to you? (choose as many as you wish)
    - Not trusting everything I see online.
    - Using a very strong password and not sharing it.
    - Clicking on "update now" after first seeing the popup about software updates.
    - Taking the time to ask the school IT department if it is ok to download a new app.
    - Not acting on it right away and just pausing whenever I come across a suspicious link.
    - Leaving all cybersecurity matters to the guys in the IT dept and just focusing on my studies.
    - Other: _____
- 12. Who do you feel is responsible for your online safety/ security right now? Check all that apply.
    - My family and I
    - My teachers and the school IT department
    - The US Government Agency that is responsible for cybersecurity
    - Ultimately, I bear most of the responsibility for the use of devices
    - Other: _____
- 13. Please name one previous cyber attack you have heard about? (When and where it happened, who was affected.)
- 14. How confident are you in your online safety and security skills? (This is about protecting yourself and your devices)

  ( ) I have no idea how to be secure

  ( ) 1 ( ) 2 ( ) 3 ( ) 4

  ( )I have a good idea of how to be secure