Chatbot as a multi-age teaching strategy

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ABSTRACT
The awareness of contemporary students for the learning process comes up against the abundant and accelerated supply of technological resources. This scenario forces teaching to be attractive, dynamic and interactive throughout the construction of autonomous and meaningful knowledge. In this way, this work aims through the active methodology "Project Based Learning" to connect through the teaching of educational robotics students of different levels of education and provide them, through the making and execution of chatbot, a new tool for autonomous study, interactive and integrated to socio-emotional factors. StudyChat SESI-SP 113 was developed by 3rd year high school students using the Scrum method and offered to 5th year elementary school students as a new multidisciplinary study resource.

Keywords: Chatbot, Project Based Learning, Educational Robotics, Digital Culture.

1 INTRODUCTION

The need for normative standardization for the elaboration of national curricula of public and private educational institutions that promote education at the preschool, elementary, secondary and higher levels has existed since the promulgation of the constitution in 1988. Laws subsequent to the Magna Carta such as the Law of Guidelines and Bases of National Education in 1996, the Law of the National Curricular Parameters of Elementary Education in 1997 for initial grades and, in 1999, for

final grades and the National Curriculum Parameters for High School in 2000 complement the specific legislation, detailing how the national teaching-learning process should be (BITTENCOURT, 2019).

The promulgation of the National Common Curricular Base for Basic Education in 2018 momentarily ends this normative set, establishing 10 general educational competencies dismembered in the following areas of knowledge: Languages and their Technologies, Mathematics and its Technologies, Natural Sciences and its Technologies and Applied Human and Social Sciences (BRASIL, 2018).

The innovation established at BNCC constitutes the promotion of the development of socio-emotional competencies and skills, in addition to the conventional curricula established in the Brazilian educational system (LISBOA & ROCHA, 2020; WORDS EDITORIAL PROJECTS, 2022). This environment is conducive to the establishment of the teaching of Educational Robotics whose educational methodology prioritizes meaningful learning from the research, discovery and construction of knowledge through plugged and unplugged activities carried out, generally, in teams (BRAUN, 2020).

The teaching of computational thinking requires diversified and effective strategies to promote the construction of autonomous knowledge; in this way, the use of active methodologies such as Project-Based Learning becomes a common and efficient tool for teaching Educational Robotics (IBARRA & SOARES, 2022).

Created to facilitate learning, from the active methodologies, and assist the teacher within the classroom, *StudyChat* SESI-SP 113 is a new autonomous study tool, which allows the student to carry out their activities without the simultaneous help of a mentor, within the platform. It was developed by students of the 3rd year of High School to have applicability in the autonomous study of students of the 5th year of Elementary School.

The application allows the teacher to create tasks based on the expectations of teaching and learning determined for each grade in the teaching of Educational Robotics of the SESI-SP Education Network (SESI-SP, 2021) and make them available to students who can remotely access this activity and perform it. In an interactive way, the chat works as a conversation in which the question and the answer alternatives are sent to the students. By choosing one of the alternatives, the software analyzes the results in an agile way and returns its assertiveness, making the difficulties and strengths of each student, or the class in general, are met and observed, making the classes more effective, as well as the evaluation process, which can easily be adapted to the needs of each student.

2 METHODOLOGY

The interaction between teachers of the curricular component Programming and Robotics of the Educational Center 113 "Milton Cordeiro Sobrosa" of the SESI-SP Network provided the

elaboration of the project entitled "CHATBOT AS A MULTIAGE TEACHING STRATEGY" from the active methodology Project-Based Learning (IBARRA & SOARES, 2022).

The creation of a content questionnaire directed to the learning process of students of the 5th year of Elementary School by the responsible teacher provided the students of the 3rd year of High School with material for the creation and development of an application based on artificial intelligence, *StudyChat* SESI-SP 113, under the guidance of the teachers involved (DORF, 1998; AFARI, 2017).

The development of the *Front-End* began in the creation of *the layout through the Figma tool, a collaborative platform to carry out the construction of* application layout. Subsequently, the coding was developed in React.js, a library used for the development of user interfaces. Among other supports used are, jQuery, JavaScript library that facilitates the manipulation of HTML and events, Axios, HTTP client that facilitates the sending of requests and treatment of the response, and *React-simple-Chatbot*, library responsible for generating a chat component.

The *Back-End* was developed in the C# Language with the .NET Framework based on the RESTful API software architecture, characterized by an API, *Application Programming Interface*, which follows the standards imposed by the REST architecture style, *Representational State Transfer*, which imposes architectural constraints that, when implemented, highlight the potential for growth of component interactions, generalization of interfaces, independent implementation of intermediate components to reduce interaction latency, strengthen security and encapsulate old systems, also called Legacy System (SAUDATE, 2013). *The Clean Code* was also used, a set of rules that organize the code in a clean way, maintaining a high level of maintainability, in addition to the rules mentioned above (BALTIERI, 2022). In its importance evidences the use of the five principles of code design OOP, Object-Oriented Programming, called by the acronym S.O.L.I.D, which is composed of *Single Responsibility*, principle that says that a class should have only one responsibility, *Open-Close*, which proposes the idea that a class is open for extension, but closed for modification (THELMA, 2022).

Liskov Substitution says that if a given class is a subtype of another, subtype class objects that can override the main class without changing any of its properties, *Interface Segregation*, a class should not be forced to depend on methods it does not use, *Dependency Inversion*, high-level classes should not depend on low-level classes, both must derive from abstraction so that certain functionality of the low-level class depends on it (AL-AHMAD, 2006). And, in order to add a layer of security in addition to the items described above, JWT was implemented, JSON Web Token, which provides a compact and independent way to transmit information through a JSON object, they bring reliability since the Token has a digital signature that uses as an algorithm the HMAC, Hash-based authentication code, that prevents information from being tampered with (BALTIERI, 2022).

Regarding data persistence, we used the SQL Server relational database hosted on Azure, and during its creation it was necessary, in addition to defining the business rule, to go through creation

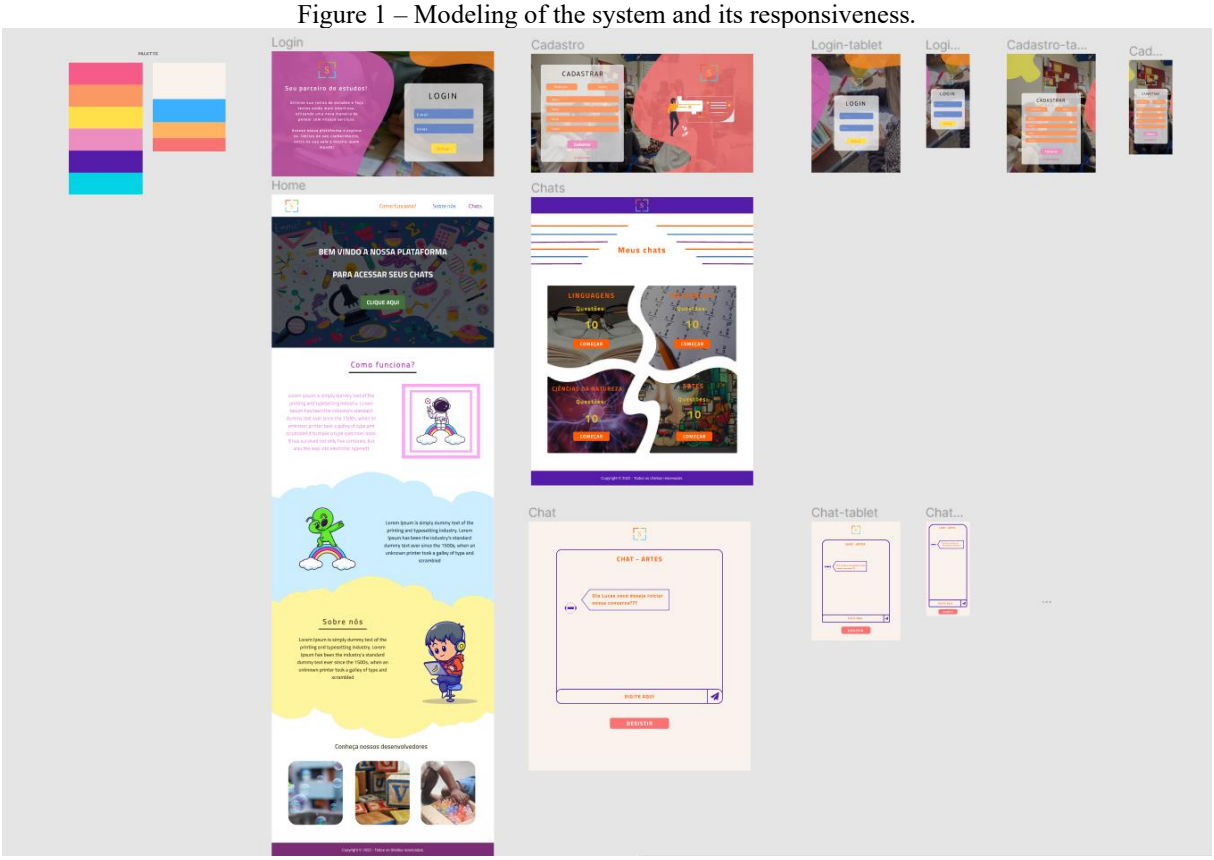
steps for a normalized database (MICROSOFT, 2022). As a first step, it was necessary to start modeling the bank with the creation of a MER, Entity and Relationship Model, and later DER, Entity Relationship Diagram. From then on, it was possible to progress to the creation of the scripts starting with DDL, Data Definition Language, a set of commands responsible for creating and manipulating *tables in the database, followed by DML, Data Manipulation Language set of commands responsible for accessing and manipulating* the data contained in a table, and DQL, *Data Query* Language aiming at querying the data (DATE, 2004).

The test of the *StudyChat* SESI-SP 113 application was carried out through an experimental class that the developers presented to the students of the 5th grade of Elementary School under the supervision of the guiding teachers.

3 RESULTS AND DISCUSSION

Creating the platform layout from the Figma tool made the design idea of *StudyChat* a more centralized reality. With it it was possible to diagnose the responsiveness, as well as the arrangement of the scene elements, creating a more improved and flashy product design. Conversational simulators use this same strategic styling tool that appeals to their users.

Figure 1 – Modeling of the system and its responsiveness.



With the schematic of *StudyChat*, in parallel it was possible to diagnose the elaboration of the *Front-End* libraries, using part of the components of the React library, as Figure 2, implementation possible from the Object Orientation and, also by the call of the API services, corroborating with the methodology adopted by customer service and cloud-based instant messaging services (GUIGIDI & MATTOS, 2018; ALVES, 2021).

Figure 2 – Import of Services and APIs.

```
import React, { Component } from 'react';
import PropTypes from 'prop-types';
import ChatBot from 'react-simple-chatbot';
import css from './teste.css'
import logo from '../../assets/logo.png'
import api from '../../services/api'
```

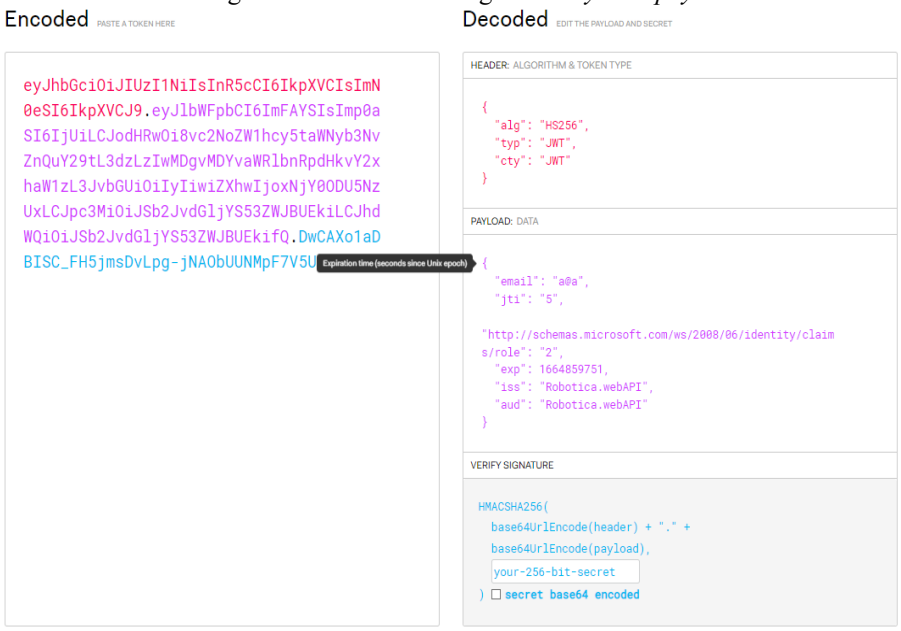
Idealizing better communication between the sectors of the application, the Axios library was used, responsible for the flow of information from students and teachers between Front-End and API in the *StudyChat platform*. In the context of programming, Figure 3, the use of the 'setState' method was parameterized, assuming that, if any information is missing from the register, the system automatically detects and requests the correction.

Figure 3 – Axios Library Consuming the Backend

```
cadastrarAluno = (event) => {
  event.preventDefault();

  this.setState({ erroMensagem: "", isLoading: true })

  api.post('/api/Estudantes', {
    nome: this.state.nome,
    idSerie: this.state.idSerie,
    idUsuarioNavigation: {
      email: this.state.email,
      senha: this.state.senha,
    }

  })

    .then(resposta => {
      if (resposta.status === 201) {
        this.setState({ isLoading: false });
        this.setState({ erroMensagem: "Cadastrado com sucesso" });

        this.props.history.push("/")
      }
    })
    .catch((error) => {
      this.setState({ erroMensagem: error.response.data, isLoading: false });
    })
}
```

To increase the level and credibility of application security, *JSON Web Token*, codenamed JWT, was used as a strategy. Thus, it is possible to generate custom authentication codes so that both client and server can have access and credibility recognized, causing the unauthorized entry of attacks to be nullified. In Figure 4, it is possible to observe the composition of the JWT in 3 parts, as described by Saudate (2013), making the application and its entry authorizations secure.

Figure 4 – JWT containing the *StudyChat payload.*

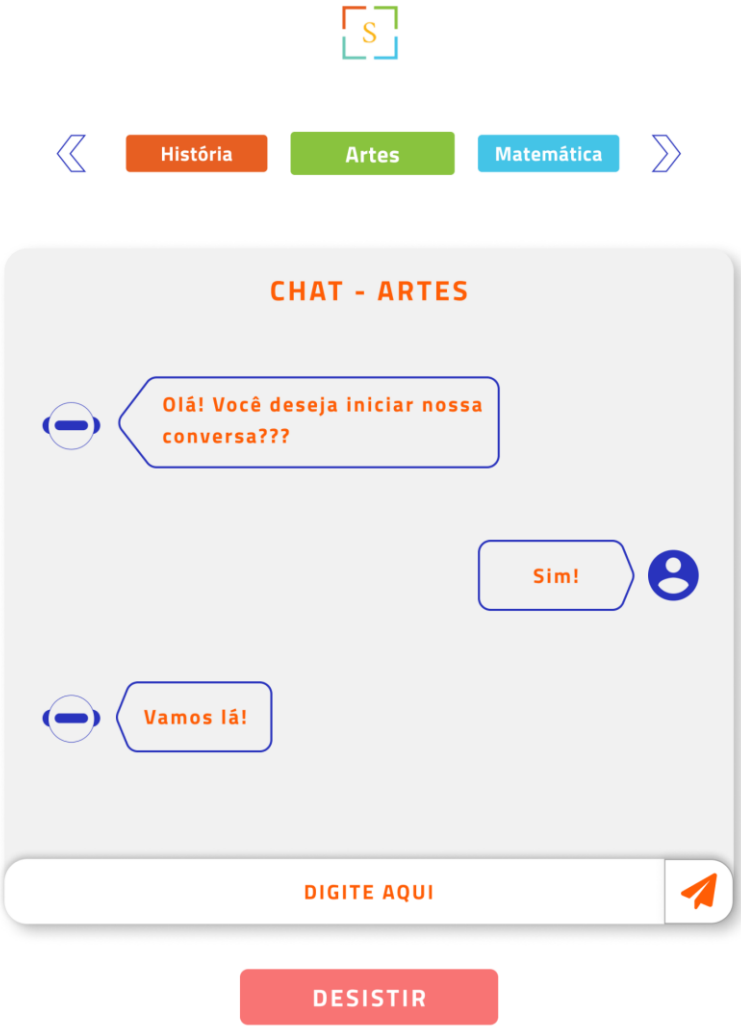


Together with JWT, it was also essential to use the Rest API (FIELDING, 2000), responsible for the processing of application data, making the data follow the flow from the Front-End to the Back-End. This allows both client and server to be connected to the main database. Thus, in Figure 5 and 6 we can observe the language coding, which determines the centralization and integration of the questionnaire choices. In Figure 6, you can see the final result in the interaction part.

Figure 5 – Rest API containing the choice options.

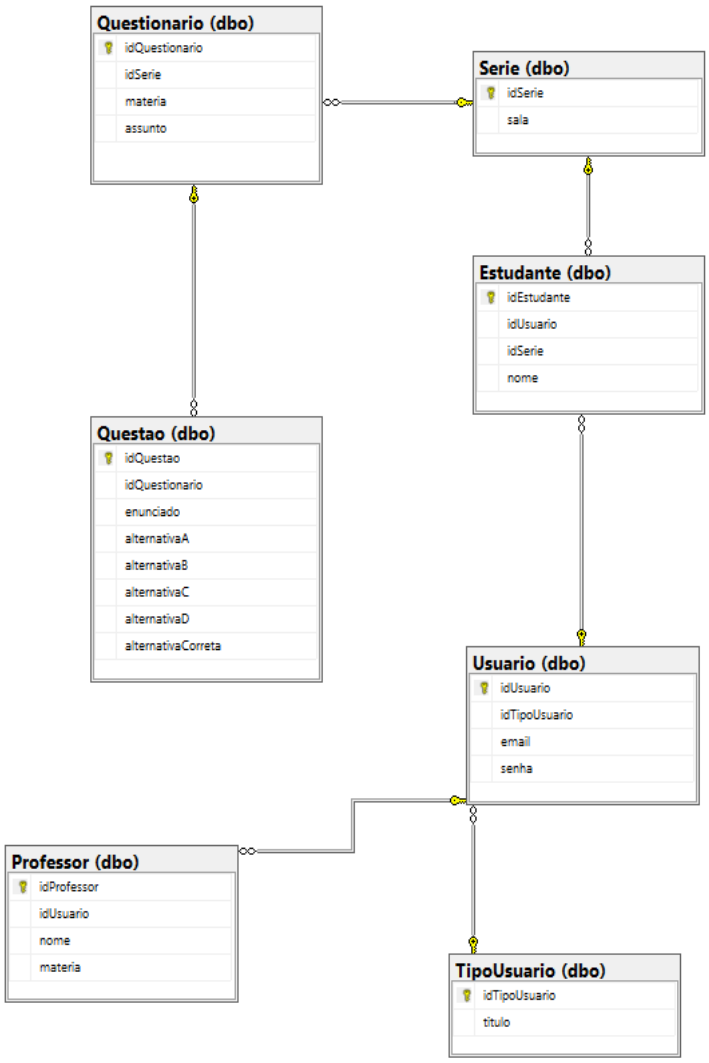
```
using Microsoft.AspNetCore.Mvc;
using System;
using System.Collections.Generic;
using System.IdentityModel.Tokens.Jwt;
using System.Linq;
using System.Threading.Tasks;
using WebApi_Robotica.Domains;
using WebApi_Robotica.Interfaces;

namespace WebApi_Robotica.Controllers
{
    [Produces("application/json")]

    [Route("api/[controller]")]
    [ApiController]
    public class QuestionariosController : Controller
    {
        private readonly IQuestionarioRepository _questionarioRepository;
        private readonly IEstudanteRepository _estudanteRepository;

        public QuestionariosController(IQuestionarioRepository contexto, IEstudanteRepository ctx)
        {
            _questionarioRepository = contexto;
            _estudanteRepository = ctx;
        }

        [HttpGet]
        public IActionResult Listar()
        {
            try
            {
                int idUsuario = Convert.ToInt32(HttpContext.User.Claims.First(c => c.Type == JwtRegisteredClaimNames.Jti).Value);
                Estudante e  = _estudanteRepository.BuscarPorIdUser(idUsuario);

                return Ok(_questionarioRepository.Listar(e.IdSerie));

            }
            catch (Exception ex)
            {

                return StatusCode(500, ex.InnerException.Message);
            }
        }

        [HttpPost]
        public IActionResult CriarQuestionario(Questionario q)
        {
            try
            {

                _questionarioRepository.Cadastrar(q);
                return StatusCode(200, "Questionario criado com sucesso");
            }
            catch (Exception ex)
            {

                return BadRequest(ex);
            }
        }


        [HttpDelete("{Id}")]
        public IActionResult Delete(int Id)
        {
            try
            {

                _questionarioRepository.Deletar(Id);
                return StatusCode(200, "Questionario apagado com sucesso");


            }
            catch (Exception ex)
            {
                return StatusCode(500, ex.InnerException.Message);
            }
        }

        [HttpPut("{Id}")]
        public IActionResult Put(Questionario QuestionarioAtualizado, int Id)
        {
            try
            {

                _questionarioRepository.Atualizar(QuestionarioAtualizado, Id);
                return StatusCode(200, "Alterado com sucesso");

            }
            catch (Exception Erro)
            {
                return BadRequest(Erro);
            }
        }


    }
}

```

Figure 6 – Interaction with the *StudyChat user.*



In order for the implementation of the application to respect the business rules requested from the academic proposal, created by professors and students, the creation of relational integrity was analyzed, using the Database (Figure 7), according to DATE (2004).

Figure 7 – Relationship of Relational Entities - Database.



After an experimental analysis with students of the 5th grade of elementary school, it is possible to visualize a positive aspect of the process. Initially, an explanatory conversation wheel was applied, in which it was possible to diagnose the work with *the chat*, also showing a little about the universe of programming, citing each of the stages and their functions. With the execution of the tool, Figure 8, it was possible to show the way in which *the StudyChat* SESI-SP 113 presents itself, making the classes more dynamic and interesting. Efficiency similar to that obtained in *chatbots* aimed at learning languages or socio-educational skills (DA SILVEIRA, 2019; SILVA et al, 2020).

Figure 8 - User Interaction Screen

We hope that *StudyChat* will be a platform to help the teacher, creating an ecosystem that facilitates evaluations, as well as the optimization of time, a strong point that highlights the quality in future studies.

4 FINAL CONSIDERATIONS

The encouragement of autonomous and meaningful learning through the application of active methodologies, such as Project-Based Learning, becomes promising as it favors the natural protagonism of the students involved in the construction of knowledge, establishing, in addition to curricular skills, socio-emotional competencies.

The interaction between students of different ages provided a unique experience in the teaching and learning process noted in the expansion of vocabulary related to programming language, in the questioning and argumentative positioning of the students involved and in the practice of programming responsible for the creation of a real and applicable product – the *StudyChat* SESI-SP 113.

Ethical cooperation between education professionals is a promising and efficient strategy for the creation of new teaching tools and methodologies, as evidenced by our project.

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