Tampere University of Applied Sciences

Edupreneurs

A Digital Platform for Education Institution and civil organizations and companies

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ABSTRACT

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Edupreneurs, a digital platform for education institution and civil organizations and companies

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The main purpose of this project was to build a digital platform for the Southern African region to ensure end-users benefit from using this platform for their educational needs, institutional needs, and company's needs.
This application helps to filter any organization registered in the platform based on categories. There might be thousands of different schools, organizations, and companies registered, but a click could filter a specific search input accordingly. Registrations are different carried out for education, organizations, and company. There are different service options for the target group to choose while registration is made.
This platform is funded by the Southern Africa Innovation support programme, and the project is developed by a group of computer engineers, educators, and etrepreneurs from Finland (I.e Eduix Ltd), and Namibia (I.e Glowdom, and the Namibian Business Innovation Institution).

Key words: javascript, react, bootstrap, node.js

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ABBREVIATIONS AND TERMS

TAMK	Tampere University of Applied Sciences
B2C	Business to Customer
B2B	Business to Business
UI	User Interface
JSX	JavaScript Syntax Extension
XML	Extensible Markup Language
DOM	Document Object Model
API	Application Programming Interface
NPM	Node package manager
NGO	None Government Organization

1 INTRODUCTION

Edupreneurs is a project aiming at building network and empowering education entrepreneurs toward a strong education technology ecosystem in the Southern Africa region. The purpose of this project was to develop a digital platform in the South African Development Community able to influence the education technology infrastructure and the human capacity for education development in the South Africa region. The platform is mainly in the use of different stakeholders.
In particular, the education section, companies, and organizational institutes could take advantage by registering a free package with their information distributed into the platform for end-user. Edupreneurs web application software frontend and backend project are developed by the association between Eduix Ltd and Glowdom companies.

2 ABOUT EDUPRENEURS

Edupreneurs project was funded by the Southern African Innovation Support program where the Namibian University of Science and Technology with Namibian Business Innovation institute called for digitalization of the education system in Southern African. The project client-side is developed by Eduix Ltd company at Tampere city office while data are fetched from E-lomake database. Edupreneurs project targets schools, companies, and organizations working for the education sector as stakeholder to make their digital online presence visible. Edupreneurs promotion event planned to give free registration to schools, companies, and organizations in the Southern African region was on 30 May 2021.

The package services were free for registration for a limited time and was sponsored by Southern Africa Innovation Support. The free limited registration started from May will last December 2021. After which stakeholders will start paying for the services.

In the registration form, the provided services influence searching for specific schools, organizations, and companies. There might be a several registrations in million, by categorizing service can help user to figure specific requirement on advance search.

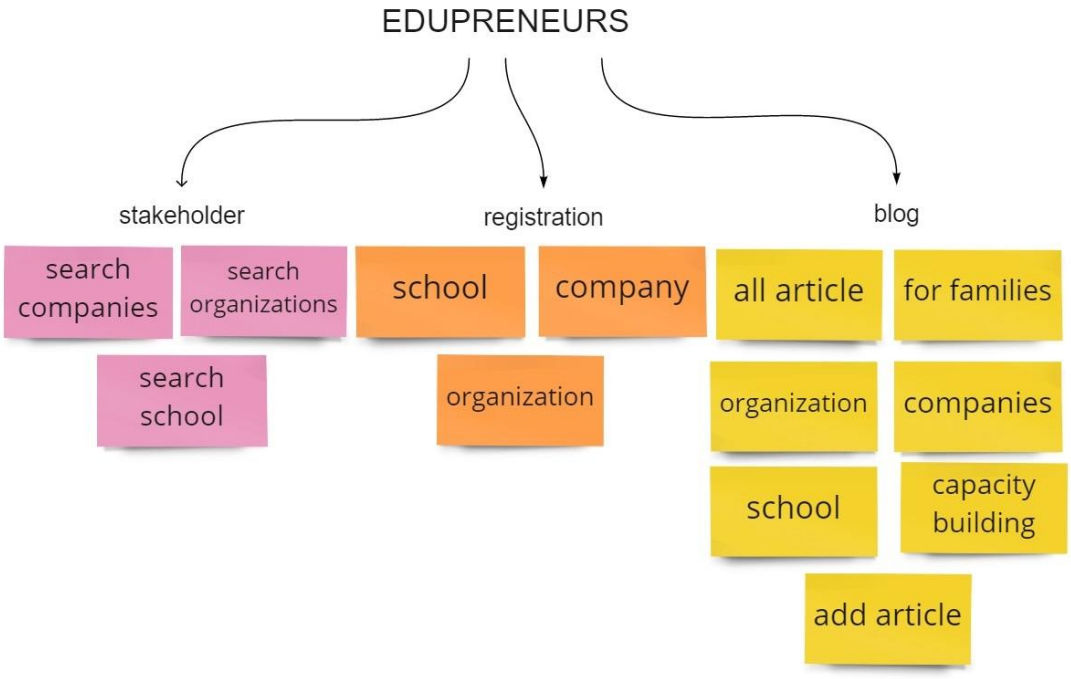


FIGURE 1. Edupreneurs map.

2.1. Digital platform

Registrating with Edupreneurs makes it possible to make them visible digital information of stakeholders to the world by their type. This digital platform can be utilized by the following:

- Education institutions
- Businesses
- Organizations
- Online education courses
- Distributing software agencies
- Marketing agencies
- Construction companies
- Cleaning companies
- Nursing schools
- Agricultural
- Farmers
- Industries
- Shops

2.2. Edupreneurs business service

Service that is considered in Edupreneurs is B2C (business to customer) and B2B (business to business) during 1st March – 31st July 2021 Edupreneurs was offered a pro bono by SAIS funded (Laite, Lais n.d.). The digital platform, however, will be a paid service for businesses, educational institutions, and organizations after the project funding has ended.

2.2.1 Business to customer

This part of the platform channelling solutions which are infrastructure suppliers' and equipment such as customers books, office materials, internet connectivity and school services. A stakeholder could categorize different criteria of their search in business to customer services (Laite, L. 2021).

2.2.2 Business to business

Businesses and institutions will be showcased in the digital platform while business owners will network with relevant stakeholders. Edupreneurs also promote companies and products making them visible for marketing to end-user (Laite, L. 2021).

2.3. Registration of stakeholder

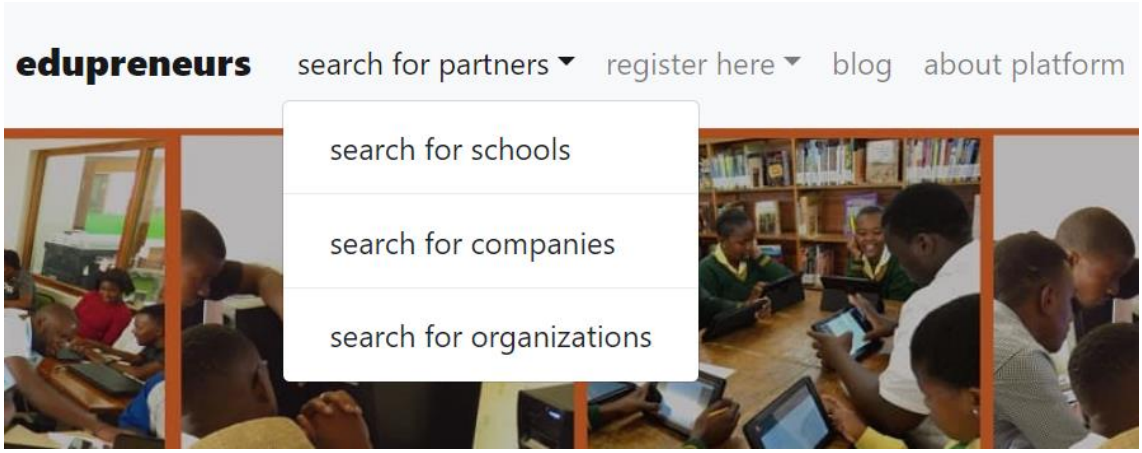
Registration of stakeholder provides options for schools, companies, and organizations to register their services to the digital platform. A stakeholder must have an interest to purchase a particular package that is relevant to their proposal since the register was free from 1st March – 31st December stakeholders will not be charged until that each registration would pay some certain fee later.
Training is provided to the registration stakeholders: Participating in training helps to build an initiate capacity building for Edupreneurs. The workshop gives instruction and information on using the web application and registration.
The requirement for registration is very simple and stakeholder need to have a laptop/pc and mouse to get online registration.

TABLE 1. Registration packages

	Basic	Premium	Diamond
Schools	*Name of school *Address (country, city) *Contact information *1 Picture *Logo	*Includes Basic package *More than 1 picture *Education proposal *Team description	*Includes Premium package *YouTube link *Service description *Facilities
Companies	*Name of school *Address (country, city) *Contact information *1 Picture *Logo	*Includes Basic package *More than 1 picture *Education proposal *Team description	*Includes Premium package *YouTube link *Service description *Facilities
Organizations	*Name of school *Address (country, city) *Contact information *1 Picture *Logo	*Includes Basic package *More than 1 picture *Education proposal *Team description	*Includes Premium package *YouTube link *Service description *Facilities

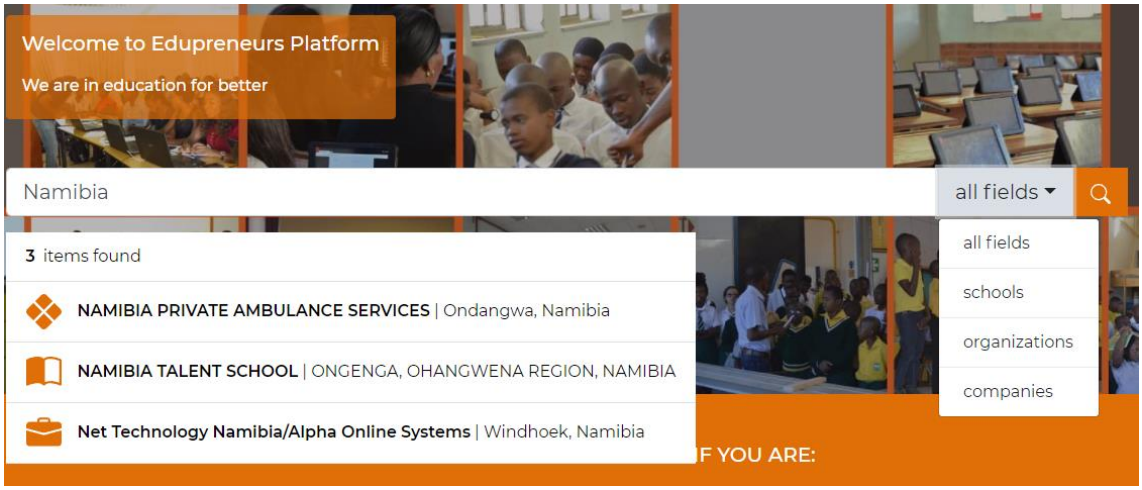
2.4. Search for partners

The purpose of this dropdown button is to search for partners, such as schools, companies, and organizations that are already registered to the platform. They are handled to be seen in a dropdown element of the navigation bar (from now on, referred to as navbar) so that a user would select based on his choice of selection to see the stakeholders' services, information, image, videos, and links. The design and template are considered by the project manager from and Glowdom company and with the assistance of Eduix consultancy. It is more understandable that the partners are expected to have a different page for queries to the platform.



PICTURE 1. Navbar search for partner field.

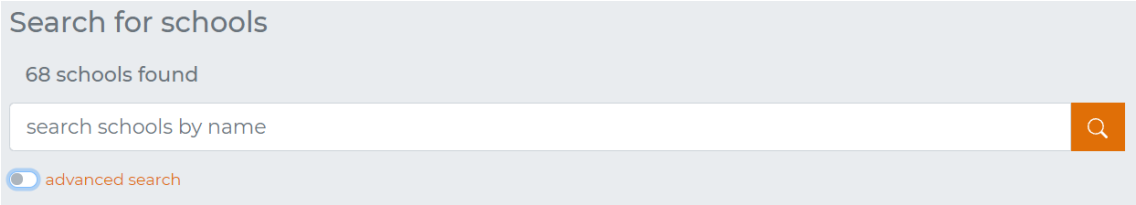
Edupreneurs can filter all partners (schools, organizations, companies) by typing the partner's name in the field. In addition, it is easy to select a partner from the dropdown menu.



PICTURE 2. Search partner field main page.

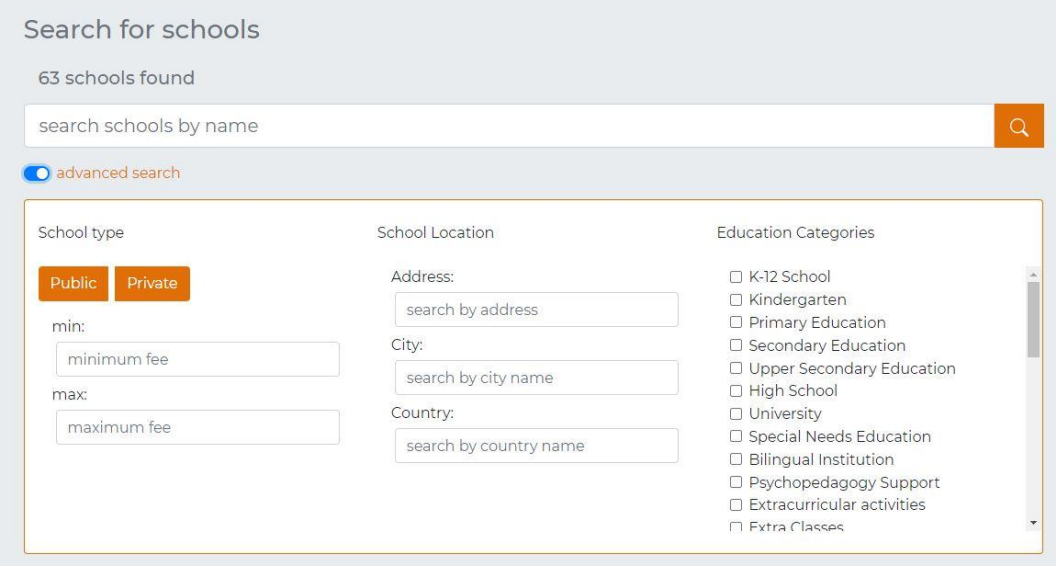
2.4.1 Search for schools

The purpose of “search schools” function is to make it easy for families who want to receive information about a selected school for their children. The information includes services provided by the schools that are available on this platform. This service makes it easy for parents to choose which school they want their children to attend.



PICTURE 3. Search school partners.

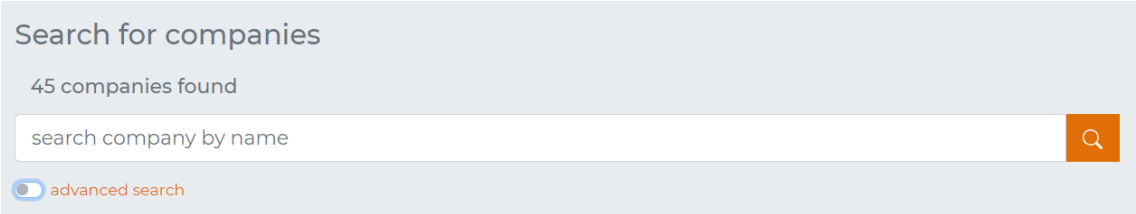
The button, “advance search” is switching users to a comprehensive detail so that a family can search from a category of service provided by a registered school (Picture 4). The public and private schools can be easily accessed and searched in the same way for the location of a particular school. Finally, schools can be searched by selecting the last option from education categories.



PICTURE 4. Search school partners with categories.

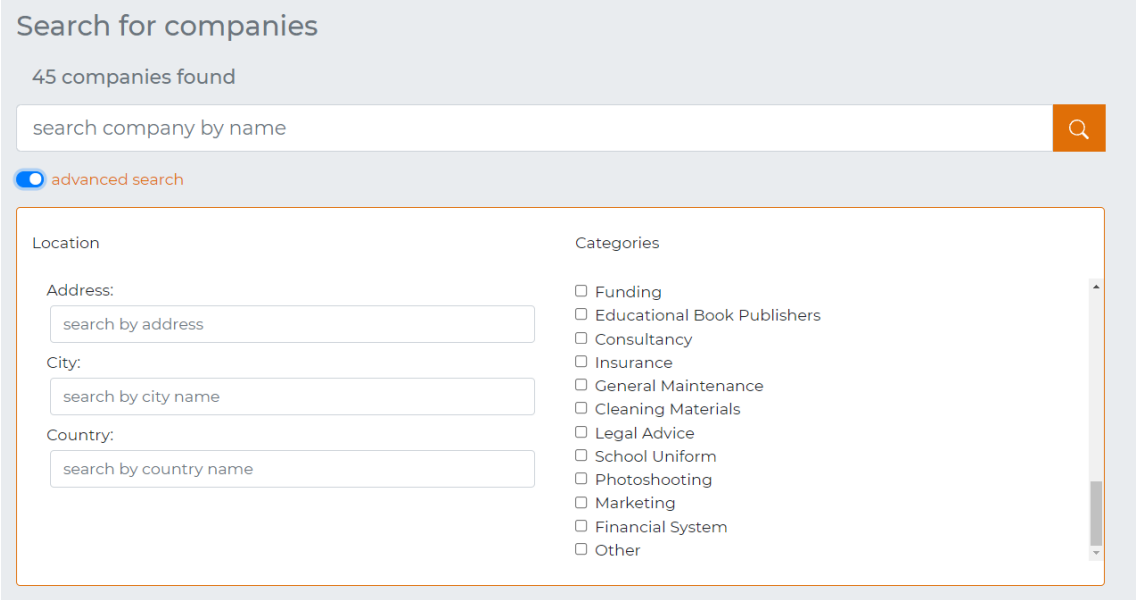
2.4.2 Search for companies

The purpose of searching for companies function is for users to find out about product, materials, and website of the companies. When a company registers on Edupreneurs, their information is shown based on contents they provided in E-lomake form during registration. It is easy for a user to see all companies a page but with the “search company”, function the user can find details about the company.



PICTURE 5. Search companies.

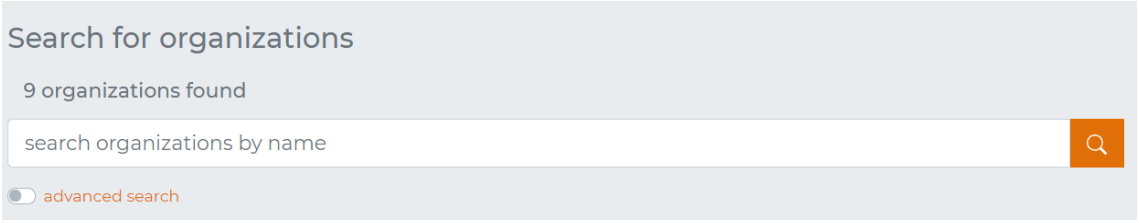
The button “advance search” is for switching to a comprehensive detail, so that a user can find a customer near him/her. The user must enter the available specifications in field to see that specific information about a company accordingly. There might be customers who may want to see some services of the company and features that are shown in categories.



PICTURE 6. Search companies with categories.

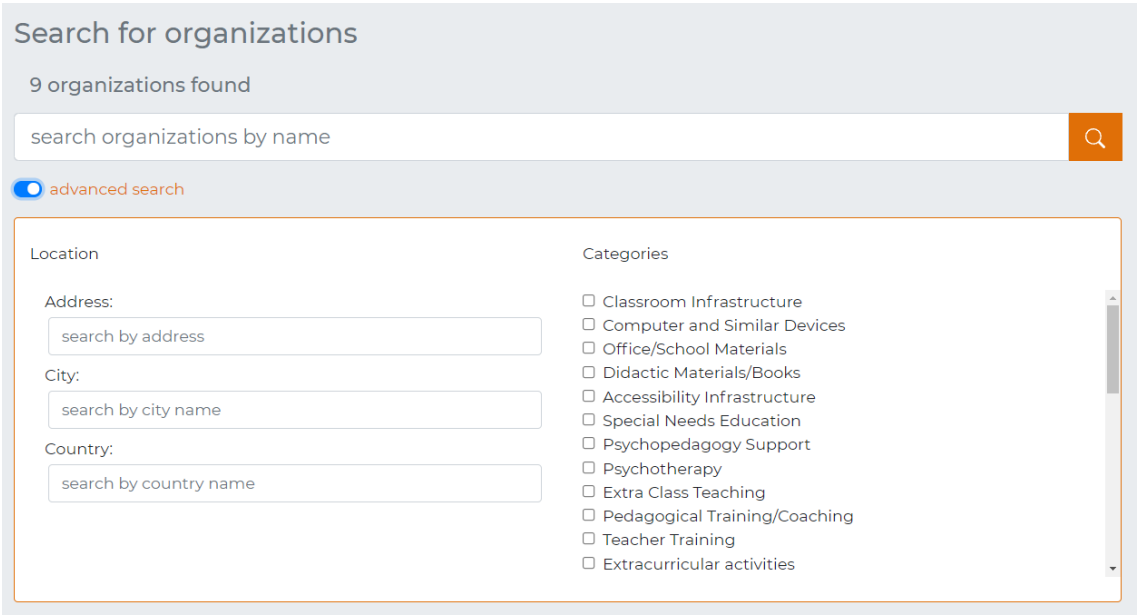
2.4.3 Search for organizations

The purpose of searching for an organization is to find an NGO for financial support or a grant. There are several organizations that lead to solving some of the world's problems and this platform can help a user find out about different NGO's and their activities based on the information they provided during their registration in E-lomake form.



PICTURE 7. Search organization.

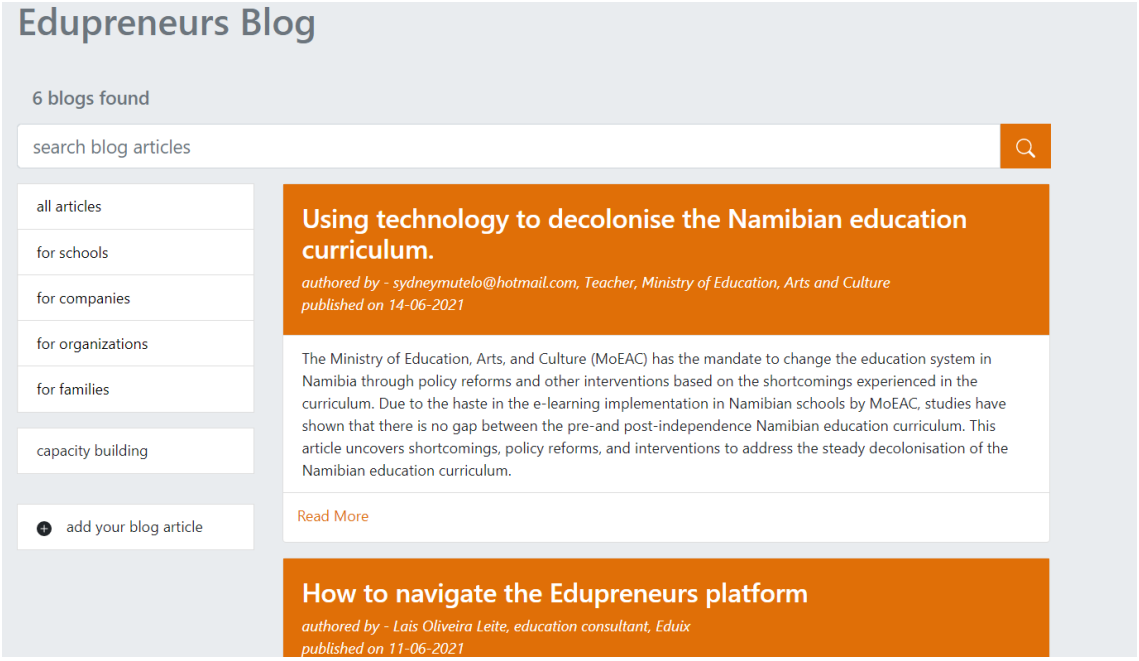
On the Edupreneurs platform, the design of the "advance search" button is based on filtering and flexibility for a user to find out about organization using filters "categories and location" to find services provided to their region.



PICTURE 8. Search organization with categories.

2.4.4 Edupreneurs blog

The purpose of a blog is to communicate relevant information about a particular platform to website users. That information is according to the registration of stakeholders filling in the required form. The page for blogs is divided separately for each stakeholder. One field shows three blogs per pagination method in the application. Also, users can add their information using the add blog article icon. The blogs contain information such as events, meetings, seminars, and much more relevant information. The button **Read More** shows full description with images of that blog.



PICTURE 9. Blog page.

3 STRUCTURE OF THE APPLICATION

The initial structure and design of the Edupreneurs web application were mainly based on market demanding features such as React framework which render the component in real-time. The entire application's skeleton is built with following command:

create-react-app client

However, this command cannot install all required modules and packages. The developer has to install all necessary packages for the full functionality of the application. The client-server application and layout have been constructed by developers of Eduix Ltd, all the characteristics, elements, and design are React standard. It has been built in a responsive layout application that can load in different platform devices such as mobile, desktop, and mini devices. Technically the performance of loading a user interface page in React framework is shown in below (Picture.11).

PICTURE 10. Network Panel. Show red colour loading speed of main page.

3.1. Client

Edupreneurs project was built with React framework with the addition of some vanilla JavaScript. A simple HTML page does not make functional web software without adding a framework to the client. In a web application that a user sees everything in a display, it is either client or frontend, objects such as text, image, and UI that the browser displays. There is not that much difference between frontend and client, the application which runs locally in the virtual machine is client, and the client application that runs in your web browser is called frontend (Martin, Thoma. 2021). The components of the project are explained in Picture 12.

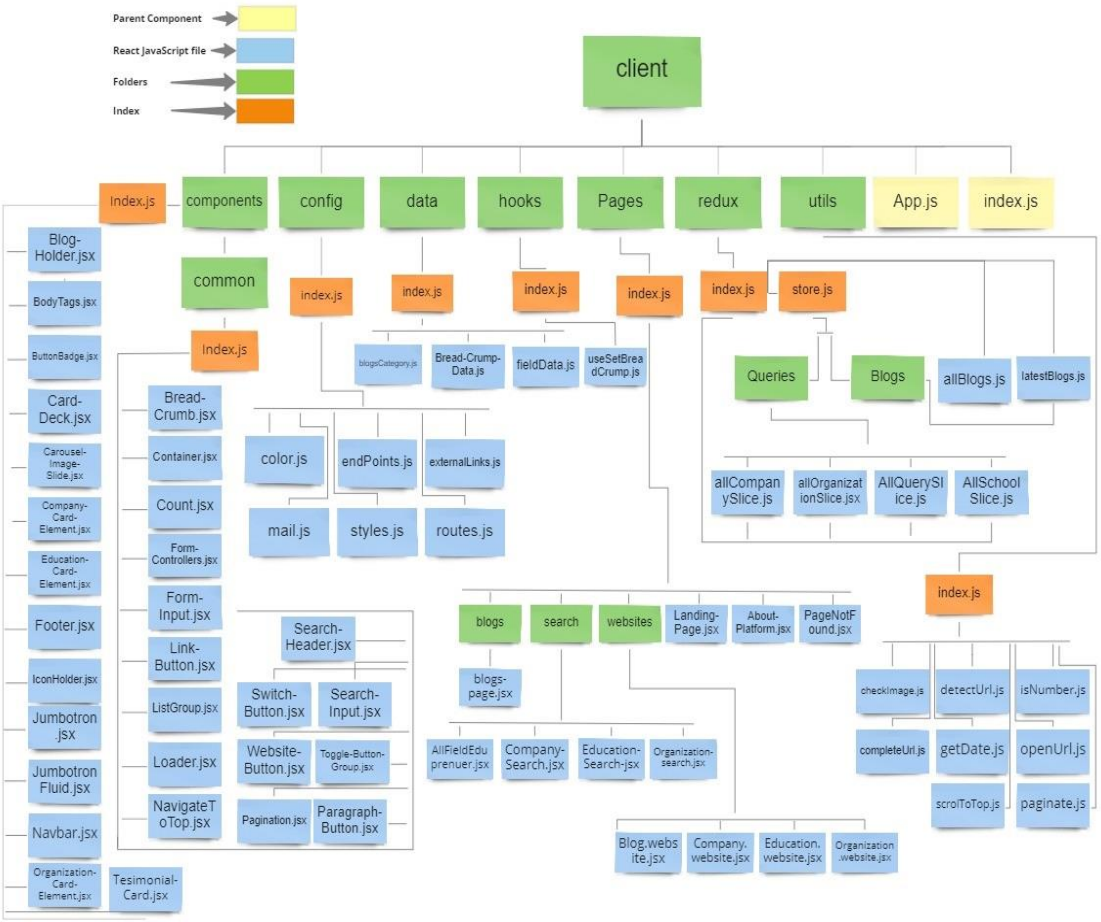


FIGURE 2. Client map.

3.2. React

The ReactJS framework is a free open-source library to build single-page components and render each state component to the DOM (Document Object Model). It is required to install the different packages on the client side. React is the most popular framework of JavaScript language and is used for complex user interfaces (Liu, Shanhong n.d).

Every React application has at least one root component. That represents the application. The root component contains other route components or subcomponents.

React allows developers to create large web applications in a single web application, without reloading the whole page. The main purpose of React is to render each component that is selected and mount it in UI. So, the React application is fundamentally a tree of components, and the props can be called from the mother component. In React Hook it is simple to navigate the page with a feature browse history and route the path to the other component (React Hook. n.d).

For instance, Navbar's components route multiple page components to their page. The React hook framework has a feature that routes the path with browser history to navigate the other components.

- Dropdown (search schools, search companies and search organizations)
- Register here (register schools, register companies and register organizations)
- Blog
- About platform
- Color palette
- Login button

PICTURE 11. Navbar component.

3.2.1 Features of react

- **Simplicity**

It is a simple component-based approach. A well-defined life cycle and a plain JavaScript makes React a very simple to build a professional web application that supports mobile devices (React Hook. n.d).

React component file has JSX extension to make it compatible for both HTML and JavaScript.

- **Easy implementation**

To build an application in ReactJS, a developer requires to understand CSS and HTML. Edupreneurs project have been built using React Redux Toolkit which is an official React user interface binding layer for Redux (Abramov, Dan n.d).

3.2.2 React redux toolkit

React Redux Toolkit is the official UI layer for Redux, which allows React components to read data from the store and dispatch an action to update (Abramov, Dan n.d). For the current project Edupreneurs, the Redux Toolkit package has been implemented to change the state from different query slices.

The current version of React Redux Toolkit is **@reduxjs/toolkit: ^1.5.1.**

A very beneficial part of React Redux Toolkit is data fetching and cache queries that helps the developer understand code better.

3.2.3 React Redux toolkit features

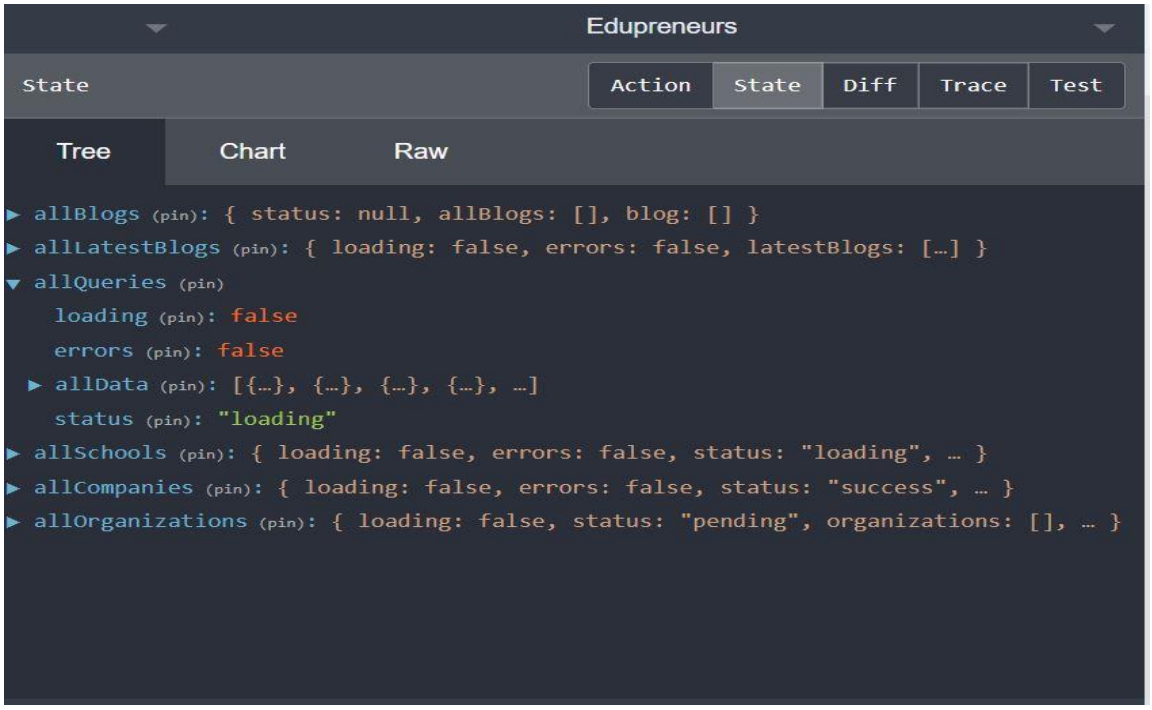
The features which have been used for the Edupreneurs application play a key role in the fetching and storing data and display them on the screen for end-user. Some of these features are described below.

configureStore()

A configureStore () function wraps createStore to provide simplified configuration options. This configuration combines slice, and reducer. The configureStore by default has feature like Redux thunk (Abramov, Dan n.d). There is an extension for Redux DevTools in the panel (Picture 12).

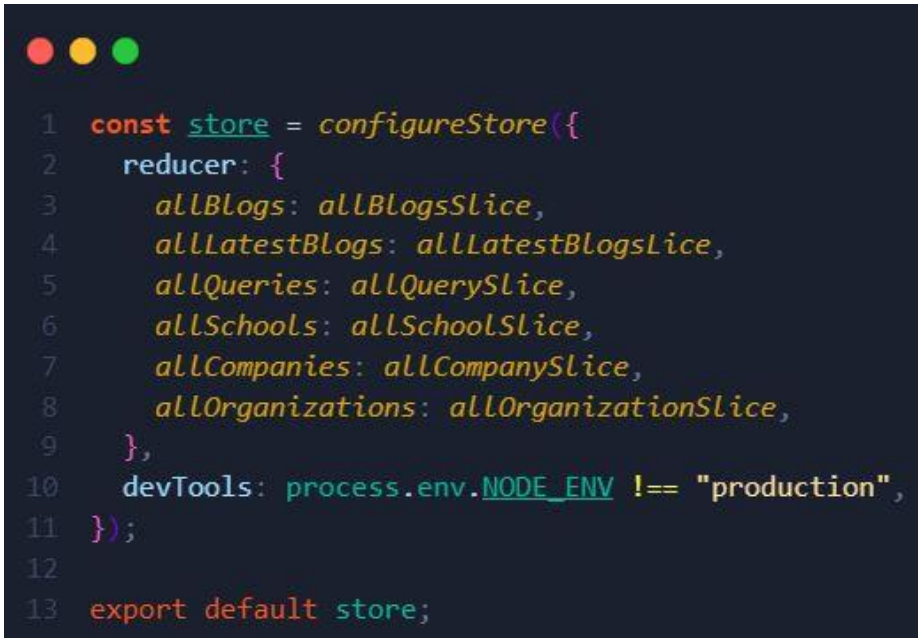
PICTURE 12. configure Store library.

As shown in picture 13, the store holds all the query states from allBlogs, allLatest Blogs, allQueries, allSchools, allCompanies, and allOrganizations which were requested from the server.



PICTURE 13. Redux devTool.

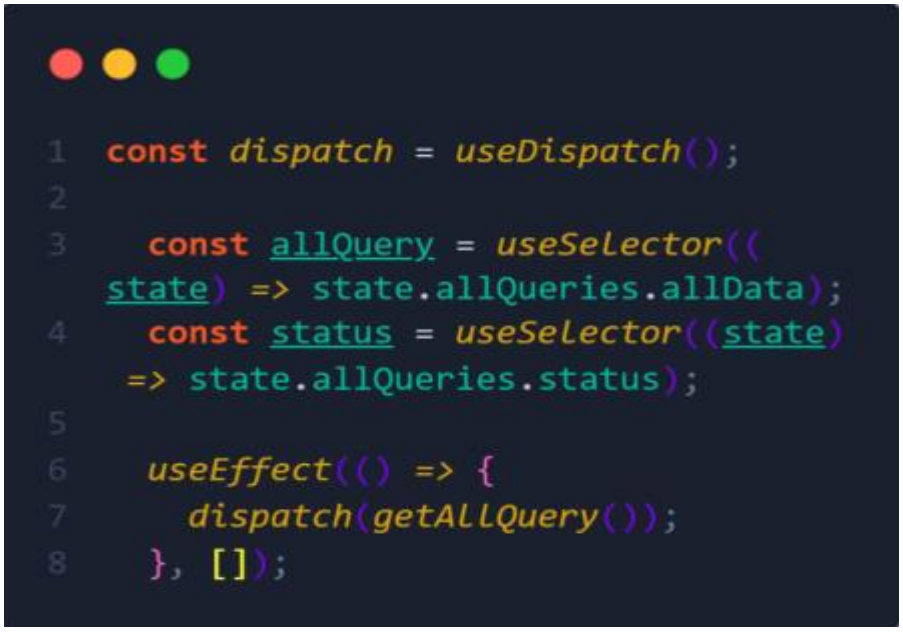
For good understanding or development experience, React-Redux configures store that accepts a single configuration object parameter. In Redux, the traditional way is to store the data into a state in any slice and give a parameter name that prevents confusion, so that all the state fetched from the server could be in the proper sense that frontend can get via dispatch feature (Abramov, Dan n.d).



```
const store = configureStore({
  reducer: {
    allBlogs: allBlogsSlice,
    allLatestBlogs: allLatestBlogsLice,
    allQueries: allQuerySlice,
    allSchools: allSchoolSlice,
    allCompanies: allCompanySlice,
    allOrganizations: allOrganizationSlice,
  },
  devTools: process.env.NODE_ENV !== "production",
});

export default store;
```

PICTURE 14. React store in redux

All queries in the React-Redux method which is holding all data states can be mounted in React Hook. If the status of a state is not available, it gives pending status to the user. However, if there is an error, it will reject.



```
const dispatch = useDispatch();

  const allQuery = useSelector((
state) => state.allQueries.allData);
  const status = useSelector((state)
 => state.allQueries.status);

  useEffect(() => {
    dispatch(getAllQuery());
  }, []);
```

PICTURE 15. Mount allQuery

createSlice()

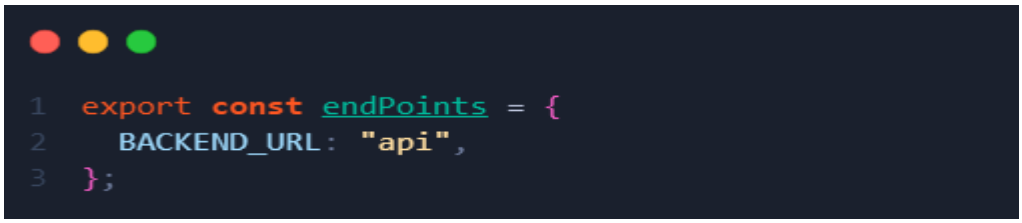
The function createSlice() contains a name, have an initial states and reducer (Abramov, Dan n.d). The name is used for reference, the initial state has a reducer, and extra reducer that holds all the actions to alter the reducer state. In extra reducers, there are three arguments to implement in the initial state. If the user retrieves all queries, the action is fulfilled, if the user does not retrieve any data, it would be pending but if the client requests and the server does not fulfill the extra reducer will reject the request.

```
const allQuerySlice = createSlice({
  name: "allQueries",
  initialState: {
    loading: false,
    errors: false,
    allData: [],
  },
  reducers: {},
  extraReducers: {
    [getAllQuery.fulfilled]: (state, { payload }) => {
      state.allData = [
        ...payload.companies,
        ...payload.educations,
        ...payload.organizations,
      ].sort((a, b) => a.name.localeCompare(b.name));
      state.loading = false;
    },
    [getAllQuery.pending]: (state) => {
      state.status = "loading";
    },

    [getAllQuery.rejected]: (state) => {
      state.status = "rejected";
    },
  },
});

export default allQuerySlice.reducer;
```

PICTURE 16. CreateSlice function.

3.3. Application programming interface

Building application programming interface (API) was designed with the requirement of the clients of Edupreneurs web application in such a way that user could find their sources in the search field. Designing an application programming interface is not as easy as when building for the client to fetch data. This means it is an intermediary between the client and server providing the sources. In ReactJS there are multiple ways to fetch data with the client. Before getting the data, it is necessary to link server to the frontend. Therefore, React has a feature to link server directly through a proxy in the package.json file. The type of request used for the Edupreneurs project is only **GET** request which has been implemented by the Eduix E-lomake database. It receives all requests from all data including data from each section such as schools, organizations, and companies. The name **API** variable is to reference the request URL address, so this returns HTTP status code then returns an object of variables



```
export const endPoints = {
  BACKEND_URL: "api",
};
```

PICTURE 17. End point variable.

```
export const getAllQuery = createAsyncThunk(
  "allQueries/getAllQueries",

  async (_,{_rejectWithValue_}) => {
    const { allQueryUrl } = endPoints;
    try {
      const response = await axios.get(
allQueryUrl);
      return response.data;
    } catch (error) {
      return rejectWithValue(error.response.
data);
    }
  }
);
```

PICTURE 18. Get all Query request.

3.3.1 HTTP requests

An HTTP request is made by a client, to a named host, which is located on a different server in the application. The purpose of the request is to access an information resource on the server and **GET** method is used to read information of resources. HTTP response code of 200 (OK) will be returned for a successful request.

TABLE 2. Server-side APIs

HTTP	Operations	specification	collections
GET	Read	{host_address}/companies {host_address}/ companies /options	companies categories
GET	Read	{host_address}/educations {host_address}/educations/options	schools categories
GET	Read	{host_address}/organizations {host_address}/organizations/options	organizations categories
GET	Read	{host_address} /?search=	allQueries
GET	Read	{host_address}/blogs	allBlogs
GET	Read	{host_address}/blogs/latest	latestBlogs

In an error case, it most often returns a 404 or 400 (NOT FOUND) or (BAD REQUEST).

3.4. Integrating client with application programming interface

When designing the frontend with ReactJS framework, at the initial step, consider to make the skeleton or the template of the application responsive and flexible to suit the react-bootstrap package. At this stage of implementation with the APIs, the frontend looks for the backend's code to fetch the data stored or to store data into a database table. The Node.js frontend fetches data from E-lomake database with GET method (Eduix Ltd product n.d).

The URL address of the API service is https://edupreneurs.ahaa.glowdom.com

TABLE 3. Corresponding routes for client and server sides.

routes	fetched server-side
url_address/blog	/api/blogs
url_address /all-results	/api/?search=
url_address /school-search	/api/education
url_address /company-search	/api/companies
url_address /organization-search	/api/organizations
url_address /school-search	/api/education/{id}
url_address /company-search	/api/companies/{id}
url_address /organization-search	/api/organizations{id}

3.4.1 Connecting client-side to server-side

The objective of this method is to secure connections between frontend and backend servers, therefor a third party integrated library is required to give access to another server via a proxy which is particularly called HTTP-proxy-middleware.

The purpose for HTTP-proxy-middleware is to connect servers such as express or browser synchronization to the frontend (Chim, Steve. n.d).
Edupreneurs frontend sends requests to the server, should be noted that the file name should be setupProxy.js in the project root repository so that it can communicate between client and server.

```
module.exports = function (app) {
  app.use(
    createProxyMiddleware("/api/**", {
      target: "http://192.168.1.195:33025",
      changeOrigin: true,
      secure: false,
      pathRewrite: { "^/api": "" },
      headers: {
        apikey: process.env.API_KEY,
        origin: null,
      },
      onProxyReq: function (proxyReq, req, res)
{
        proxyReq.setHeader("accept-encoding",
"identity");
      },
    })
  );
};
```

PICTURE 19. Connecting proxy server.

3.5. Libraries and installation

Node.js packages are managed with the npm – node package manager - command line tool. There are millions of packages available for developers, such as bootstrap, react-bootstrap, react-router-dom, Axios, react-bootstrap-icon, react-scroll-up-button and, react-use and many more.

3.5.1 Bootstrap version 4.6.0

Bootstrap is a framework that builds a responsive website layout that adapts to different screen sizes. A responsive application provides optimal viewing and interactive experience that is easy to read and navigate across a wide range of devices. The CSS stylesheet, which is a collection of dropdown menu, forms, rows, columns, buttons, and many more is included in the core of the Edupreneurs project for the design and colors. It is necessary to import the bootstrap library to the root of the application. Hence it will not affect the design of other components (Bootstrap Library. n.d).
The Library is installed using the following command:

npm install bootstrap –save

PICTURE 20. Importing bootstrap package

3.5.2 React-Bootstrap version 1.5.2

The React-Bootstrap is used to replace the standard Bootstrap. Each component has been built from the scratch as a true React component. The Bootstrap at its basic build has its own component and compatibility. The React component standard gives more control over and purpose of each component (React Bootstrap Library. n.d).

React-Bootstrap allows component to be added to the virtual DOM. These components are actual React Components, so there is no need to use jQuery to retouch the DOM. The React-Bootstrap also uses React-style components that consist of all the lengthy class information that Bootstrap would commonly use. All of this is done under the hood and the result is clean and the code is more readable.

The library is installed using the following command:

npm install react-bootstrap@next bootstrap@5.1.0

3.5.3 React-Dom version 1.5.2

The Dom is a programming interface for hypertext transfer protocol and XML applications (React Dom n.d). It is a method that can change the document structure, quality, and content. The virtual document object model is a part of a family tree that files elements and qualities and contents as objects and properties. Whenever a render () method makes a pointed tree from a component state and updates, the tree responses to change in the data model. The idea behind ReactJS Dom is that it changes only a particular state in a component.

Differences in real DOM:

- react component use
- return HTML code in react render () method
- replace class attribute name to className
- react component get changed to react group

3.5.4 React-Router-dom version 5.2.0

The React-router plays a very important role in an application since it is a process in which you navigate different components with the user's request. This feature can handle changing URL addresses in the browser that matches any route. The React-Router-Dom is a library system of React and its task is to create routing the application web pages. It provides an asynchronous address on the HTTP browser, and it will display the data on that page (React Router Dom. n.d).
The library is installed using the following command:

npm install react-router-dom –save

```
<Route
            path="/school-search"
            render={() => (
              <EducationSearch
                searchField={searchField}
                setSearchField={setSearchField}
              />
            )}
          />
```

PICTURE 21. School search route

3.5.5 React-scroll-up-button version 1.6.4

The purpose of React-scroll library is to have a fixed scroll from top to bottom of the screen. This would give by default a button, it could be customized but it only gives a ready-made code by installation (React Scroll Button n.d).
The library is installed using the following command:

npm installation react-scroll-up-button

```
import { TinyButton as ScrollUpButton } from "react-scroll-up-button";
```

PICTURE 22. Scroll button

3.5.6 React-use version 15.3.3

React-use package installation is very useful for controlling the coordination of the screen. This can help the user to move the cursor smoothly (React use n.d). The feature React-use is only used with React function component and it supports all browsers. There is no side-effect to other components on the project.
The library is installed using the following command:

npm install react-use –save

```
import { useWindowScroll } from "react-use";
const ScrollToTop = () => {
  const { y: pageYOffset } = useWindowScroll();
  const [visible, setVisiblity] = useState(false);
  const { greyColor, LighterDarkerGrey } = colors;
  const { ScrollToTopPosition } = styles;
```

PICTURE 23. Scroll to window coordination

3.5.7 Axios version 0.21.1

Axios is a JavaScript library that provides a Promised-based HTTP client for Node.js (Zabriskie, Matt n.d). It has a special role in the application programming interface because it deals with the requested data from the server. It can take advantage of JavaScript's async and await to make code more readable. With await Axios request it can pause your code on the line until the Promise is fulfilled, then returning value as shown below (Picture 24).

npm install axios –save

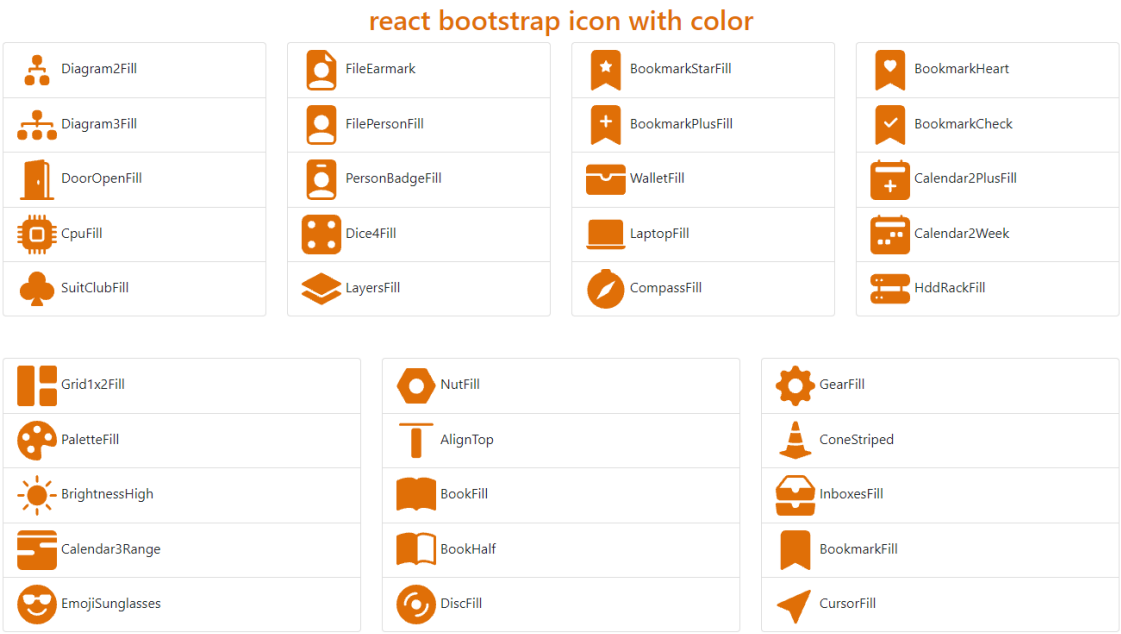
PICTURE 24. Axios get request

3.5.8 React-Bootstrap-Icon version 1.4.0

The React gives every component their tags and there is a small difference between Bootstrap icon and React-Bootstrap-Icon (React bootstrap icons n.d). The React-Bootstrap-Icon is traditional from classic to react component therefor react uses it is own tags. The React icons are very useful for design of the user interface and managing the screen. Icons catch user's attention with one look and are is easy to click with the mouse pointer. React-Bootstrap-Icon reduces the size of the project. Also, to developers its resizing and color combination to the project is flexible.

The library is installed using the following command:

npm install react-bootstrap-icons –save



PICTURE 24. Beact-Bootstrap-Icons

4 DISCUSSION

The objective of the project was to give users a high-performance web service that gives users high-quality assurance of the information provided on the website. There were several requirements for the project to meet. These requirements are discussed below.

4.1. Performance

The Lighthouse extension tool is an open-source application. This tool is used for ensuring the quality of a web application (The Lighthouse dev tools n.d). A user can run this tool against any website in the public with or without authentication. It checks for performance, accessibility, progressive web app, and search engine optimization. This extension can be used in the chrome browser. It is used to check every element that matches the google search engine standards. The Lighthouse audits a single page at a time, and each red option indicates low performance.

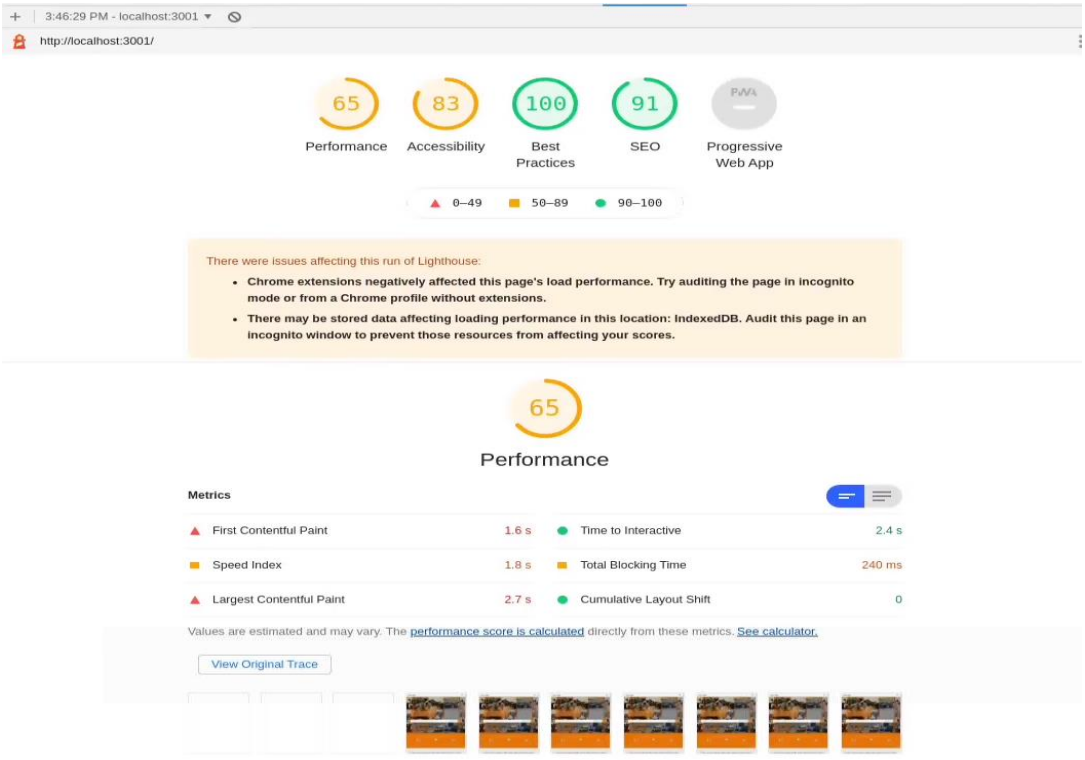
4.2. Usability

The lighthouse service evaluates the user interface from the accessibility and efficiency point of view. This service can evaluate all possible information on a page e.g. pictures, text, button etc. It is a large scale testing tool that exploits both technology and human psychology. Before exposing the web application to ultimate load, it is required to check the stability in the intended working condition. This can give cover to the web application in a working atmosphere. The testing can be done at anytime. But the main responsible task is to determine and monitor resources consumption, identify elements, graphical user interface processing, and application responses.

4.3. Evaluation report

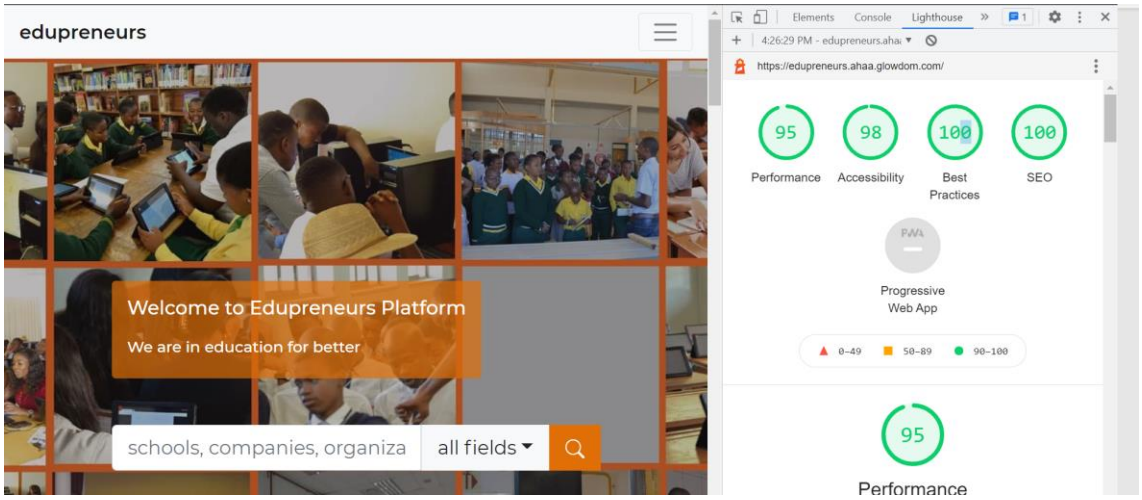
The lighthouse audit report for an early version of Edupreneurs is shown in Picture 28. Lighthouse reported following list of items to be resolved:

- button do not have an accessible name
- image elements do not have [alt] attributes
- background and foreground colours do not have a sufficient contrast ratio
- element does not have a [lang] attribute
- preload largest contentful paint image
- remove unused JavaScript
- ensure text remains visible during web font load
- serve static assets with an efficient cache policy



PICTURE 25. Lighthouse audit

These results can be used for improving the performance and accessibility of the application for better end user experience. These green results are shown below after solving the items.



Picture 26. Lighthouse result after

REFERENCES

Abramov, Dan. n.d. React Redux Toolkit, and documentation authors. Read 12 .08.2021. https://redux-toolkit.js.org/introduction/getting-started

Baker, Mitchell. 2021.Chief Executive Officer of Mozilla Foundation. Read 23.09.2021. https://developer.mozilla.org/en-US/docs/Web/API/Document_Object_Model/Introduction

Bootstrap. n.d. The Bootstrap library source. Read 05.10.2021. https://getbootstrap.com/

Chim. Steve. 2021. The http proxy middle maintainer. Read 01.09.2021. https://github.com/chimurai/http-proxy-middleware

Eduix Ltd. n.d. Elomake online formjack. Read 27.08.2021. https://e-lomake.fi/fi/

Facebook Open Source. n.d. ReactJS framework v17.0.2. Read 12.08.2021. React – A JavaScript library for building user interfaces (reactjs.org)

Jia. Jimmy Nick. 2021. The react-bootstrap maintainer. Read 21.09.2021. https://react-bootstrap.github.io/about/#team

Leite, Lais Oliveira. 28.05.21. Networking and empowering education stakeholders from Southern Africa. Read 30.05.2021 https://eduix.com/blog/2021/05/28/networking-and-empowering-education-stakeholders-from-southern-africa/#more-793

Laite, Lais Oliveira. 28.05.2021. Southern African Innovation Support programme. Read 30.05.2021. https://eduix.com/blog/2021/05/28/networking-and-empowering-education-stakeholders-from-southern-africa/

Liu, Shanhong. 19.08.2021. Most popular web framework among developers worldwide. Read 08.09.2021. Most used web frameworks among developers 2021 | Statista

Martin, Thoma. 22.12.2021. Difference between frontend/Client-side. Read 28.12.2021. https://softwareengineering.stackexchange.com/questions/188521/is-the-term-front-end-synonymous-with-client-side-if-so-is-this-always-the

React Bootstrap Icons. n.d. React bootstrap icons. Read 05.10.2021. https://icons.getbootstrap.com

React Hook. n.d. The React functional component. Read 11.11.2021. https://reactjs.org/docs/hooks-intro.html

React use. n.d. The React use library. Read 11.11.2021. https://www.npmjs.com/package/react-use

React Scroll Button. n.d. The React scroll up button. Read 12.11.2021. https://react-scroll-up-button.com/

React Dom. n.d. The React Dom. Read 10.10.2021. https://reactjs.org/docs/dom-elements.html

React Router Dom. n.d. The React Dom training and example. Read 05.10.2021. https://v5.reactrouter.com/web/guides/quick-start

The Lighthouse devtools. n.d Lighthouse devtools. Read 30.06.2021. https://developers.google.com/web/tools/lighthouse

Zabriskie, Matt. 2014. The Axios project library. Read 06.11.2021. https://axios-http.com/

APPENDICES

Appendix 1. package.json, the main core of application runs on.

```
{
  "name": "client",
  "version": "0.1.0",
  "private": true,
  "dependencies": {
    "@reduxjs/toolkit": "^1.5.1",
    "@testing-library/jest-dom": "^5.11.4",
    "@testing-library/react": "^11.1.0",
    "@testing-library/user-event": "^12.1.10",
    "axios": "^0.21.1",
    "bootstrap": "^4.6.0",
    "http-proxy-middleware": "^2.0.0",
    "react": "^17.0.2",
    "react-bootstrap": "^1.5.2",
    "react-bootstrap-icons": "^1.4.0",
    "react-dom": "^17.0.2",
    "react-redux": "^7.2.4",
    "react-router-dom": "^5.2.0",
    "react-scripts": "4.0.3",
    "react-scroll-up-button": "^1.6.4",
    "uuid": "^8.3.1",
    "web-vitals": "^1.0.1"
  },
  "scripts": {
    "start": "react-scripts start",
    "build": "react-scripts build",
    "test": "react-scripts test",
    "eject": "react-scripts eject"
  },
  "eslintConfig": {
    "extends": [
```

```
      "react-app",
      "react-app/jest"
    ]
  },
  "browserslist": {
    "production": [
      ">0.2%",
      "not dead",
      "not op_mini all"
    ],
    "development": [
      "last 1 chrome version",
      "last 1 firefox version",
      "last 1 safari version"
    ]
  }
}
```