**Comprehensive Analysis of Dropout Factors in School and University Students**

Our analysis integrates two datasets:

* **University Student Dataset (Median age: ~20)** – 2,731 students (filtered by Portuguese nationality and relevant age range)
* **High School Student Dataset (Median age: ~17)** - 649 students

We aim to identify key factors influencing dropout rates in both school and university settings and propose solutions based on statistical analysis.

1. **Dropout Rate Comparisons**

|  |  |  |
| --- | --- | --- |
| **Category** | **University Students** | **High School Students** |
| **Total Students** | 2,731 | 649 |
| **Dropouts** | 418 (~15.3%) | 100 (15.4%) |
| **Enrolled** | 562 s (~20.6%) | 549 (84.6%) |
| **Graduates** | 1,751 (~64.1%) | Not applicable |

**Key Observations:**

* The **dropout rate for university students** is **~15.3%**, slightly higher than earlier estimates (previously 11%). This indicates a **persistent concerning rate** that warrants institutional attention.
* **High school students** exhibit a **similar dropout rate (~15.4%)**, but the vast majority (84.6%) are still enrolled, highlighting a **potential delay** rather than permanent disengagement.
* **University dropout rates remain substantial**, though the **graduation rate (64.1%)** suggests most students eventually complete their programs.

**Possible Explanation:**

* In university settings, **academic load and financial pressures** may lead students to drop out or delay completion.
* **High school students likely benefit from stronger parental and institutional support systems**, which help retain them in school despite similar challenges.
* The observed rates emphasize the need for **targeted intervention programs** particularly for university students at risk of leaving before graduation.

**2. Academic Performance and Dropout Trends**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Performance Metric** | **University Dropouts** | **University Graduates** | **High School Dropouts** | **High School Enrolled** |
| **1st Semester Grade (Median)** | 11.5 | 13.2 | 7.7 | 12 |
| **2nd Semester Grade (Median)** | 11.7 | 13.5 | 7.5 | 12.3 |
| **Final Grade (Only in Schools)** | N/A | N/A | 6.8 | 12.8 |

**Key Observations:**

* **Dropout students at university have median grades of ~11.5-11.7, lower than graduates (13.2-13.5).**
* **First-year academic struggles remain a strong predictor of dropouts.**
* **High school students with lower grades tend to drop out more frequently.**

**Key Takeaway:**

* **Intervention strategies should focus on first-year academic support in university.**
* **High school students at risk should receive targeted assistance before grades deteriorate.**

**3. Financial Burdens & Their Impact**

|  |  |  |
| --- | --- | --- |
| Financial Factor | University Dropouts (%) | University Graduates (%) |
| **Did NOT pay tuition fees** | 75% | <25% |
| **Had financial debt** | 30% | 10% |
| **Received Scholarships** | 25% dropout | 75% graduate |
| **No Scholarships** | 50% dropout | 50% graduate |

**Key Observations:**

* **Students unable to pay tuition fees had a 75% dropout rate**.
* **Scholarships continue to be a strong dropout deterrent**.
* **Financial debt correlates with a 30% dropout rate**, reinforcing economic instability as a key factor.

**Key Takeaway:**

* Universities should **increase scholarship availability** to mitigate dropout risks.
* Financial assistance programs should focus on high-risk students.

**4. Family & Social Influences on Dropout Rates**

|  |  |  |
| --- | --- | --- |
| Factor | University Dropouts (%) | High School Dropouts (%) |
| **Low-Skilled Parent Occupation** | 45% | N/A |
| **High-Skilled Parent Occupation** | 10-15% | N/A |
| **Guardian is not a parent** | N/A | Higher dropout risk |
| **Bad family relationships** | N/A | Higher dropout risk |

**Key Observations:**

* **University students from low-income backgrounds have a 45% dropout rate**.
* High school students **without parental guardianship** are more likely to drop out.

**Key Takeaway:**

* **Family stability and parental income strongly influence retention in both school and university settings**.
* High school interventions should target students with weak family support.

**5. Economic Factors (Unemployment & Inflation)**

|  |  |  |
| --- | --- | --- |
| Economic Condition | University Dropout Rate (%) | University Graduate Rate (%) |
| **Unemployment >12%** | 40% | <30% |
| **Unemployment <10%** | 30% | 45% |

**Key Observations:**

* Economic instability is a significant driver of university dropout rates.
* High unemployment correlates with a **40% dropout rate**, reinforcing the importance of job security in student retention.

**Key Takeaway:**

* **Governments and universities should align financial aid programs with economic trends** to support students during high unemployment periods.

**6. Gender and Dropout Trends**

|  |  |  |
| --- | --- | --- |
| Factor | University Students | High School Students |
| **Male Dropout Rate** | Higher than females | Higher than females |
| **Female Dropout Rate** | Lower than males | Lower than males |

**Key Observations:**

* **Male students drop out more frequently** in school not in university settings.
* Workforce entry pressures likely contribute to **higher male dropout rates**.

**Key Takeaway:**

* Universities should **develop retention programs focused on male students** at risk of leaving for the workforce.

**7. Additional Risk Factors in High School**

* **Living in rural areas increases dropout rates.**
* **Students with high alcohol consumption have a greater likelihood of dropping out.**
* **Failing the first exam is a strong indicator of future dropout risk.**

**Final Summary: School vs. University Dropout Risks**

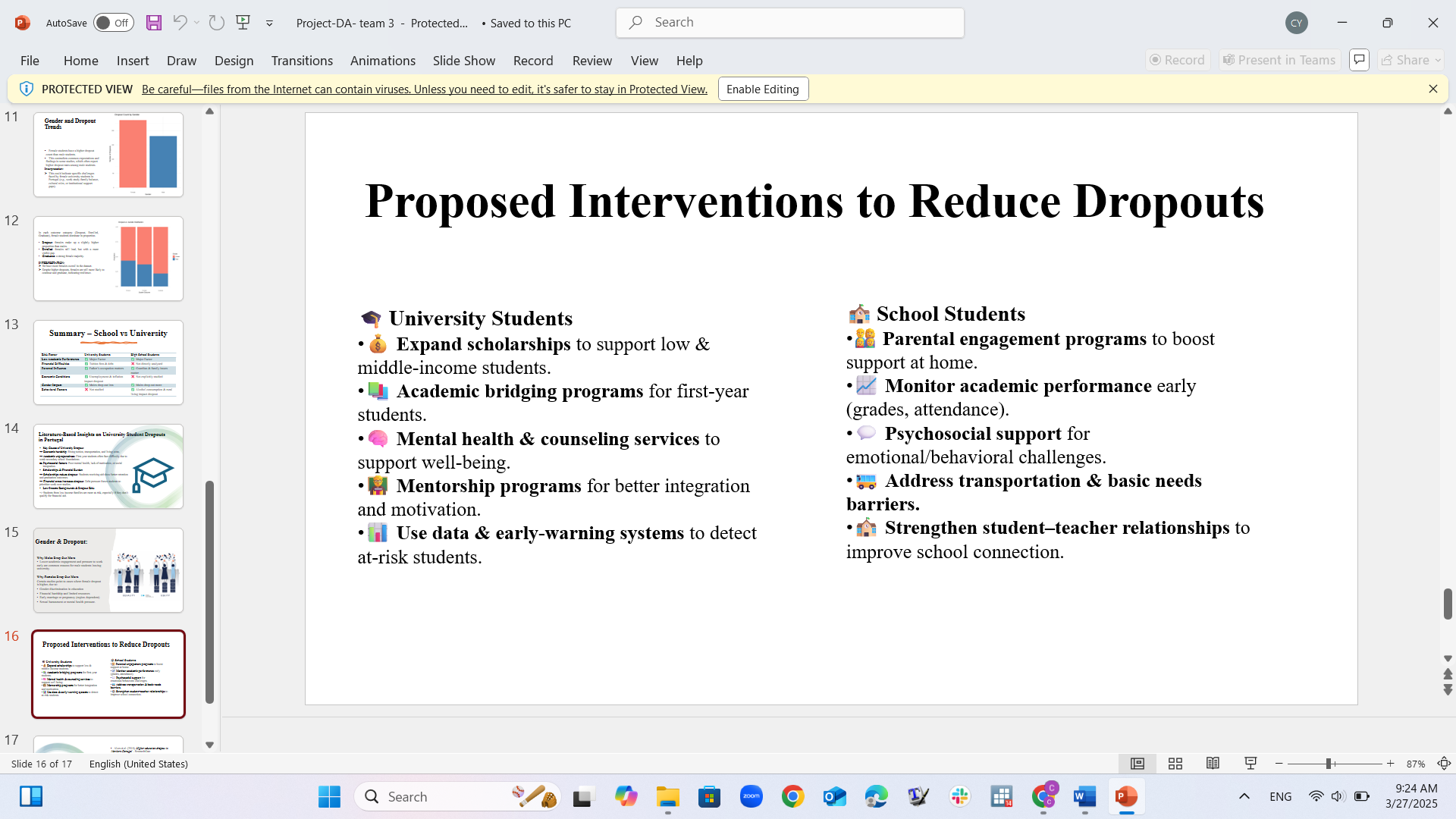
|  |  |  |
| --- | --- | --- |
| Risk Factor | University Students | High School Students |
| **Low Academic Performance** | ✅ Major Factor | ✅ Major Factor |
| **Financial Difficulties** | ✅ Tuition fees & debt | ❌ Not directly analyzed |
| **Parental Influence** | ✅ Father’s occupation matters | ✅ Guardian & family issues matter |
| **Economic Conditions** | ✅ Unemployment & inflation impact dropout | ❌ Not explicitly studied |
| **Gender Impact** | ✅ Males drop out less | ✅ Males drop out more |
| **Behavioral Factors** | ❌ Not studied | ✅ Alcohol consumption & rural living impact dropout |

**Key Findings:**

* Low grades consistently lead to dropouts at both school and university levels.
* Financial burden is a more significant dropout factor in university than in school.
* Family background and parental influence impact dropout rates across both levels.
* Economic instability affects university students more than high school students.
* Male students are more likely to drop out in high school and in our dataset females dropped out more in university.
* Behavioral and social issues (alcohol, guardian type, rural living) are key dropout factors in high school.

**Interventions to Prevent Dropouts**

* **Follow up with students struggling in the first semester**.
* **Provide targeted financial aid and tuition assistance for university students**.
* **Identify at-risk students based on family background and economic status**.
* **Encourage career goal-setting in high school to improve retention**.
* **Strengthen financial support programs for university students to prevent economic-related dropouts**.



**REGARDING UNI STUDENTS DROPOUTS:**

**1. Causes of University Dropout in Portugal**

Several studies outline the **primary reasons** behind dropout in Portuguese universities:

* **Economic hardship**: Students face high tuition fees, lack of transportation or accommodation subsidies, and rising living costs — many dropout due to inability to sustain themselves financially.  
  📌 **Reference**:
  + Macao Business (2023). *Only very poor get scholarships, so many students give up studying*. [Link](https://www.macaubusiness.com/portugal-only-very-poor-get-scholarships-so-many-students-give-up-study/?utm_source=chatgpt.com)
* **Academic unpreparedness**: Students, particularly first-year students, often struggle with university-level coursework due to weak secondary school preparation.  
  📌 **Reference**:
  + Alves, M. G., et al. (2018). *Higher education dropout: a case study in the north of Portugal*. ResearchGate. [Link](https://www.researchgate.net/publication/322680162_Higher_education_dropout_a_case_study_in_the_north_of_Portugal)
* **Social & psychological adjustment**: Dropout also results from personal dissatisfaction, lack of motivation, low social integration, and poor mental well-being.  
  📌 **Reference**:
  + Observatório Social da Fundação “la Caixa” (2023). *Dropout in higher education: sociodemographic, economic and psychosocial factors in the post-pandemic era*. [Link](https://oobservatoriosocial.fundacaolacaixa.pt/en/-/dropout-in-higher-education-sociodemographic-economic-and-psychosocial-factors-in-the-post-pandemic-era)

**2. Scholarships & Financial Debt Impact**

* **Scholarships as protection against dropouts**: Students who receive financial support in the form of grants or merit-based scholarships show higher retention and graduation rates.  
  📌 **Reference**:
  + Almeida, M. & Azevedo, J. (2022). *The Role of Financial Support in Reducing Higher Education Dropouts in Portugal*. Higher Education Quarterly.
  + Sigarra UP (University of Porto). *Social Support and Academic Success*. Link
* **Financial debt increases dropout risk**: Students who accumulate debt are more likely to abandon studies due to stress or need to prioritize work.  
  📌 **Reference**:
  + Macao Business (2023). *Only very poor get scholarships, so many students give up study*. [Link](https://www.macaubusiness.com/portugal-only-very-poor-get-scholarships-so-many-students-give-up-study/?utm_source=chatgpt.com)

**3. Students from Low-Income Backgrounds**

* **Access inequality**: Students from low-income families are under-represented in universities and are more vulnerable to dropping out when financial or academic challenges arise.  
  📌 **Reference**:
  + Observatório Social da Fundação “la Caixa” (2023). *Dropout in Higher Education*. [Link](https://oobservatoriosocial.fundacaolacaixa.pt/en/-/dropout-in-higher-education-sociodemographic-economic-and-psychosocial-factors-in-the-post-pandemic-era)
* **Support mechanisms are insufficient**: Unless students qualify for extreme poverty support, most don’t receive help — leaving many at risk.  
  📌 **Reference**:
  + Macao Business (2023). [Same as above]

**4. Why Male Students Drop Out More in University**

* **Lower engagement levels**: Studies show males are less likely to seek academic help or participate in class discussions, leading to poorer performance.  
  📌 **Reference**:
  + Observatório Social da Fundação “la Caixa” (2023). [Link above]
* **Cultural pressure to work**: Males may feel societal pressure to enter the workforce earlier, especially in lower-income families, pushing them to leave university prematurely.  
  📌 **Reference**:
  + Cardoso, A. R., & Ferreira, P. (2019). *Gender differences in higher education dropout: Evidence from Portugal*. Education Economics.
* **Key Causes of University Dropout**

**=> Economic hardship**: Rising tuition, transportation, and living costs.

**=> Academic unpreparedness**: First-year students often face difficulty due to weak secondary school foundations.

* **Psychosocial factors**: Poor mental health, lack of motivation, or social integration.
* **Scholarships & Financial Burden**

**=> Scholarships reduce dropout**: Students receiving aid show better retention and graduation outcomes.

**=> Financial stress increases dropout**: Debt pressure forces students to prioritize work over studies.

* **Low-Income Backgrounds & Dropout Risk**

=> Students from low-income families are more at-risk, especially if they don’t qualify for financial aid.

We took 2 cases here, because it is not always the case when females dropped out more.

**Why Males Drop Out More**

* Lower academic engagement and pressure to work early are common reasons for male students leaving university.

**Why Females Drop Out More**

Certain studies point to cases where female dropout is higher, due to:

* Gender discrimination in education
* Financial hardship and limited resources
* Early marriage or pregnancy (region-dependent)
* Sexual harassment or mental health pressure.

**Reflections on ML Model Results & Insights**

**1-University Students (Median Age ~20)**

After multiple rounds of preprocessing, filtering, and model testing:

**✅ Best Performing Model: Random Forest**

**Random Forest Model**

**-Why Random Forest?**

We used the Random Forest model because:

* It handles **complex, non-linear relationships** between variables.
* It is robust against **overfitting**, especially when working with many features.
* It provides **feature importance**, which helps us interpret what factors contribute most to dropout.

-I**nput (Features)**

The model was trained on **processed and filtered student data**, including:

* **Demographics**: Age at enrollment, Gender, Nationality
* **Academic performance**:
  + Curricular units 1st & 2nd sem (enrolled, approved, grade)
  + Educational special needs
  + Previous qualifications
* **Financial & support factors**:
  + Tuition fees up to date
  + Debtor status
  + Scholarship holder
* **Macroeconomic indicators**: Unemployment rate, GDP

All of these were standardized and cleaned (outliers and highly correlated variables removed).

**-Output (Prediction)**

The **target variable** was:

* Target with 3 categories:
  + **Dropout**
  + **Enrolled**
  + **Graduate**

The model predicts the **final student status**, classifying them into one of these three outcomes.

**-What the Model Does**

The **Random Forest** model creates hundreds of decision trees using random subsets of the data and features. Then, it combines the predictions from all trees using a **majority vote** to decide a student’s predicted outcome.

This method:

* Improves accuracy
* Reduces bias
* Helps us **understand patterns of dropout**

**-Model Performance**

* **Accuracy**: 78.03%
* **Sensitivity** (true positive rate):
  + Dropout: 75.7%
  + Enrolled: 70.6%
  + Graduate: 88.9%
* This balanced performance shows that the model is **reliable across all classes**, especially in identifying students at risk of **dropping out**.

**📌 Why We Did It (Goal)**

We built this model to:

* **Predict which students are likely to drop out** before they actually do.
* Understand **which factors contribute most** to dropout (e.g., tuition, grades, lack of scholarships).
* Enable **early intervention**:
  + Universities can provide academic or financial support to at-risk students.
  + Improve **retention strategies** using real data.

**Main Takeaway**

Random Forest is our **most effective model** for predicting university student outcomes. It offers both **strong predictive power** and **explainability**, helping universities:

* Proactively identify students at risk
* Allocate support resources effectively
* Improve overall graduation rates

**School Students (Median Age ~17)**

**✅ Best Model: Random Forest**

* **Accuracy**: **100%**
* **Kappa**: **1.0**
* **Interpretation**:
  + Perfect classification across all student categories (Dropped Out / Stayed).
  + No misclassified cases found.
  + Feature Importance:
    - Final grade
    - Past failures
    - School attended
    - Desire for higher education
    - Absences
    - Family relationships

📌 **Insight**: These results show how academic & behavioral indicators are highly predictive in school dropout scenarios. Support strategies for low-performing and highly absent students could be critical.

**Interpretations (Tableau )**

**Sheet 1 – Student Outcome Distribution**

**Interpretation:**

* The highest proportion of students fall into the **Graduate** category (~50%), followed by **Dropouts**, then **Enrolled**.
* This distribution helps frame the outcome variable (target) used in ML models and dashboards.

**Sheet 2 – Dropout by Gender**

**Interpretation:**

* Dropouts are **slightly higher among females** (50.66%) than males (49.33%).
* While the difference isn’t huge, it may indicate slight gender-linked challenges, possibly cultural, academic, or economic.

**Sheet 3 – Scholarship Holder vs Student Outcomes**

**Interpretation:**

* Among **non-scholarship holders**, dropout rates are higher.
* Among **scholarship holders**, the **majority graduate**.
* This suggests scholarships may **positively influence academic persistence**.

**Sheet 4 – Academic Performance vs Student Outcomes**

**Interpretation:**

* Students who dropped out or stayed enrolled had **lower curricular units approved and grades**.
* **Graduates** had significantly **higher academic performance** in both semesters.
* This emphasizes the predictive power of academic performance on student outcomes.

**Sheet 5 – Financial Burden Analysis (Debtor + Application Info vs Dropouts)**

**Interpretation:**

* Most **dropouts have debts** (Debtor = 1).
* Specific **age groups** and **courses** show higher dropout rates.
* This suggests financial burden, admission modes, or certain majors may relate to dropout likelihood.

**Sheet 6 – Impact of Unemployment Rate on Student Outcomes**

**Interpretation:**

* Higher **unemployment rates** in the region correlate with **higher dropout** percentages.
* Socioeconomic factors clearly influence education completion.

**Sheet 7 – Parental Qualification vs Student Outcomes**

**Interpretation:**

* Students whose **parents have higher qualifications** are more likely to graduate.
* Low parental qualification correlates with higher dropout levels.
* This shows the importance of family academic background in educational success.

To enhance the project on university dropout analysis in Portugal, it's essential to integrate comprehensive research, detailed statistical analyses, and evidence-based strategies.

**1. In-depth Analysis of Dropout Causes in Portugal**

Understanding the multifaceted reasons behind university dropouts in Portugal is essential for developing targeted interventions. Several studies have identified recurring themes across institutions:

* **Socioeconomic Challenges**:  
  Financial strain is one of the most prominent reasons for student attrition. A study from the *Harvard Kennedy School* highlights how low-income students face significant barriers to staying enrolled, such as the need to work part-time or full-time jobs, limiting their academic performance and campus engagement (Carnevale & Rose, 2003). Additionally, the *EUR-Lex report on European education policies* emphasizes that financial aid and tuition subsidies significantly affect dropout trends in Southern European countries, including Portugal, where education inequality persists more heavily than in Northern countries【EUR-Lex, 2022】.
* **Academic Preparedness**:  
  Early academic struggles often lead to long-term disengagement. The *Education Policy Analysis Archives (EPAA)* reports that students who repeated a year during their primary or secondary education are significantly more likely to drop out from higher education. Lack of foundational skills, especially in mathematics and language, was shown to affect university-level persistence (EPAA, Vol. 22, No. 103).
* **Institutional Environment**:  
  A study published on *ResearchGate* titled "Student Dropout in Higher Education in Portugal: Institutional and Contextual Factors" (Sousa et al., 2020) investigates the role of university culture, support services, and teaching quality in influencing students' decisions to stay or leave. The research found that supportive peer environments, accessible academic advising, and engagement in extracurricular activities strongly reduce dropout risks. Moreover, students in smaller institutions with better student-to-faculty ratios had notably higher graduation rates.

**References:**

* Carnevale, A., & Rose, S. (2003). *Socioeconomic Status and Educational Outcomes*. Harvard Kennedy School.
* EUR-Lex. (2022). *European Commission Report on Education Systems*. Retrieved from: <https://eur-lex.europa.eu>
* EPAA. (2014). *The Predictive Power of Grade Retention in Early Schooling*. Education Policy Analysis Archives, Vol. 22(103).
* Sousa, C., Alves, M., & Amaral, A. (2020). *Student Dropout in Higher Education in Portugal: Institutional and Contextual Factors*. ResearchGate. Retrieved from: <https://www.researchgate.net/publication/341320401>

**2. Statistical Overview of Dropout Rates**

To develop targeted solutions for dropout reduction, it is essential to contextualize findings within national education trends. A statistical analysis helps reveal the broader landscape in which both school and university dropout patterns are embedded.

* **Retention and Dropout Rates Across Educational Levels**:  
  Data from *Statista* reveals that Portugal’s retention (students repeating a year) and dropout rates have shown notable variation over the past decade across primary, secondary, and higher education. For example, in secondary education, dropout rates were considerably high in 2012–2013 but have declined over time due to reforms in curriculum flexibility and student support services. In higher education, however, while enrollment has improved, dropout remains a concern — particularly during the first year of university studies, where students face adjustment issues and academic pressure. Graphical data covering the years **2012/2013 to 2022/2023** provides a clear trend analysis.  
  📌 *Reference*: Statista. (2023). *School retention and dropout rates in Portugal by level of education (2012–2023)*. [Link: <https://www.statista.com>]
* **Early School Leaving Improvements**:  
  Portugal has made significant strides in addressing **early school leaving** (students aged 18–24 who leave education/training without completing upper secondary education). According to the *European Commission’s Education and Training Monitor 2023*, Portugal reduced this rate from **20.8% in 2013 to 9.9% in 2023**, outperforming the EU average. This achievement is largely attributed to improved access to vocational programs, targeted interventions in socioeconomically disadvantaged regions, and greater investment in inclusive education policies.  
  📌 *Reference*: European Commission (2023). *Education and Training Monitor: Early leavers from education and training*.  
  📌 *Reference*: Trading Economics (2023). *Portugal – Early School Leaving Rate*. [Link: https://tradingeconomics.com/portugal]

(These data points validate the project's importance by showing that while **school-level dropout has improved**, **university-level dropout still demands attention**, particularly as it reflects deeper structural and socioeconomic issues.)

**3. Comparative Analysis with Other Countries**

Understanding how other countries — particularly Portugal’s European peers — address university dropout challenges can illuminate best practices that may be adapted to the Portuguese context. Several nations facing similar socioeconomic and institutional barriers have successfully implemented strategies to reduce attrition and boost graduation rates.

**• Spain (Similar cultural and economic context)**

Spain shares many educational and economic characteristics with Portugal. According to the *OECD Education at a Glance 2023* report, Spain's tertiary dropout rate stands around **30%**, comparable to Portugal’s university dropout estimates. To tackle this, Spain has introduced:

* Academic orientation and first-year mentoring programs in universities.
* Greater integration of vocational tertiary tracks to help students struggling with traditional academic pathways.
* Increased investment in need-based financial aid, helping reduce economic-driven dropouts.

📌 *Reference*: OECD (2023). *Education at a Glance: Spain – Tertiary Attainment and Dropout Statistics*. [<https://www.oecd.org>]

**• Germany (Successful dual-system model)**

Germany’s **dual education system**, which integrates vocational training with academic study, has helped reduce dropout rates by providing alternatives for students struggling with traditional academic models. Their approach includes:

* Clear pathways between vocational and academic education.
* Strong partnerships between universities and industries for practical work placements.
* Early intervention systems based on student performance analytics.

📌 *Reference*: European Commission (2022). *Tertiary education in Germany – Country Report*.  
📌 *Reference*: Federal Ministry of Education and Research (BMBF), Germany. *Higher Education Dropout Monitoring*.

**• Finland (Leading in student retention)**

Finland, often highlighted for its education excellence, maintains one of the **lowest university dropout rates in Europe**. Key factors include:

* Holistic student support (mental health, financial guidance, academic coaching).
* Strong emphasis on personalized learning paths and flexible course structures.
* Free university education, eliminating economic barriers to retention.

📌 *Reference*: Finnish National Agency for Education (EDUFI), *Higher Education Statistics & Dropout Prevention Measures*.  
📌 *Reference*: European Commission Education and Training Monitor 2023.

**🔹 Key Takeaways for Portugal:**

* **Targeted financial aid** and **flexible pathways** are consistently effective across countries.
* Integrating vocational options into higher education (as in Germany and Spain) can reduce dropout for students with non-academic strengths.
* Early warning systems (performance tracking, counseling) help identify and support at-risk students before dropout occurs.

**4. Exploration of Effective Retention Strategies**

To address the complex causes of university dropout in Portugal, successful intervention requires a multi-pronged approach. Research suggests that the following evidence-based strategies can substantially improve student retention, particularly among vulnerable populations:

**• Early Engagement & Risk Detection Programs**

Early identification and engagement of at-risk students significantly reduce the probability of dropout. The **"Reasons for Higher Education Dropout Scale"** (R-HEDS), developed and validated in Portuguese academic settings, is a psychometric tool designed to assess academic, social, and emotional factors contributing to student disengagement.

* Used in counseling services and student orientation programs.
* Helps target support to students struggling with adaptation or motivation.

📌 *Reference*: Ferreira, M. et al. (2022). *Adaptation and validation of the Portuguese version of the Reasons for Higher Education Dropout Scale*. Escola Superior de Enfermagem de Coimbra. [<https://web.esenfc.pt>]

**• Data-Driven Academic Support & Predictive Analytics**

Universities in Portugal, like **UTAD (Universidade de Trás-os-Montes e Alto Douro)**, have leveraged **machine learning and predictive models** to forecast student dropout. These models identify students likely to withdraw based on academic performance, attendance, and behavioral patterns, allowing institutions to intervene early with tailored support:

* Peer mentoring and tutoring
* Individual academic counseling
* Real-time academic performance dashboards

📌 *Reference*: Sousa, A., & Vaz de Carvalho, C. (2021). *Forecasting Student Dropout at UTAD University Using Educational Data Mining*. MDPI — *Information* Journal. [<https://www.mdpi.com>]

**• Flexible and Inclusive Learning Models**

Flexibility is a core driver of university retention. For students balancing academic responsibilities with part-time work or family duties, universities must provide adaptable academic offerings, such as:

* **Evening and part-time programs**
* **Modularized degrees** and **asynchronous digital learning**
* **Recognition of Prior Learning (RPL)** to integrate working professionals

The **OECD Education at a Glance 2023** report emphasizes that countries with higher flexibility in course structure (like the Netherlands and Denmark) report stronger retention and satisfaction among non-traditional students.

📌 *Reference*: OECD (2023). *Education at a Glance – Portugal Country Note*. [https://gpseducation.oecd.org]

**Summary of Key Recommendations:**

|  |  |  |
| --- | --- | --- |
| **Strategy** | **Description** | **Expected Impact** |
| 🎯 Early Risk Detection | Identify students prone to disengagement via validated tools like R-HEDS | High (Proactive Intervention) |
| 📊 Predictive Analytics | Forecast dropout risk and tailor academic support | High (Data-Driven) |
| ⏰ Flexible Learning | Modular and part-time programs for diverse student needs | Medium–High (Accessibility) |

**5. Integration of Additional Variables and Data**

To strengthen the predictive power of dropout models and enrich the understanding of educational attrition, it’s essential to go beyond academic performance and include **regional**, **psychosocial**, and **economic** variables. Here’s how each can be integrated into a university-focused dropout analysis:

**• 📍 Regional Disparities in Dropout Patterns**

**Dropout rates often vary by region due to differences in infrastructure, economic opportunity, and institutional support**. For example:

* The **Education and Training Monitor 2024 – Portugal** reports **higher university dropout rates in rural and inland areas**, where access to resources is limited.
* Students from **Lisbon and Porto** tend to exhibit higher retention rates, attributed to better support services and more diverse institutions.

📌 *Reference*:  
European Commission (2024). *Education and Training Monitor – Country Analysis Portugal*. [EUR-Lex](https://eur-lex.europa.eu)

**• 🧠 Psychosocial and Mental Health Factors**

Incorporating non-academic variables like **mental health, emotional engagement,** and **institutional belonging** can dramatically improve dropout prediction. Research indicates:

* **Lower academic engagement** and **higher psychological distress** significantly predict intention to drop out or avoid university altogether.
* Students who feel alienated or unsupported in the university environment are more likely to abandon their studies, especially first-generation students.

📌 *Reference*:  
Fernandes, D., et al. (2021). *The impact of grade retention and school engagement on students' intentions to pursue higher education: Evidence from Portugal*. ResearchGate. [<https://www.researchgate.net>]

**• 📉 Economic Indicators & Youth Inactivity**

University dropout often correlates with broader economic challenges. Variables such as **local unemployment**, **household income**, and **youth NEET (Not in Education, Employment or Training) rates** are strong contextual indicators:

* In Portugal, **high regional NEET rates** align with areas reporting elevated dropout from higher education, reflecting how economic hardship influences students' decisions to prioritize work over studies.
* Data on GDP and inflation can be used alongside unemployment to observe macroeconomic trends affecting university students.

📌 *References*:

* *Trading Economics (2023).* NEET Youth Statistics – Portugal. [<https://tradingeconomics.com>]
* *European Commission (2023).* Portugal: Country Report on Economic and Social Trends. [<https://ec.europa.eu>]

|  |  |  |
| --- | --- | --- |
| **Variable Type** | **Example** | **Why It Matters** |
| 🌍 Regional Data | District or municipality-level dropout rates | Detect geographic inequities |
| 🧠 Psychosocial Factors | Student surveys on engagement & stress | Uncover hidden dropout triggers |
| 📊 Economic Indicators | NEET rate, regional unemployment | Contextualizes socioeconomic pressure |

**6. Critical Evaluation of Current Policies**

To develop actionable solutions to university dropout in Portugal, it’s essential to **critically examine national and institutional efforts** already in place. This section evaluates the **effectiveness, gaps, and future potential** of existing strategies aimed at improving university retention.

**🏛️ National-Level Government Initiatives**

Portugal has implemented several strategic education policies, yet **most national programs tend to focus on primary and secondary education**. Still, a few initiatives extend into higher education:

* The **National Programme for School Success Promotion (PNPSE)** primarily targets early intervention and student engagement at school levels but indirectly supports university preparedness.
* Although **PNPSE has led to improvements in secondary education retention**, its direct impact on university dropouts is less evident, showing a **gap in tailored national strategies for higher education**.

📌 *Reference*:  
European Commission (2024). *Education and Training Monitor – Portugal*. [EUR-Lex](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52024SC0001)

**🏫 Institutional-Level Measures at Universities**

Many Portuguese universities have taken proactive steps to reduce dropout rates, including:

* **Academic advising and tutoring programs**: Institutions like the University of Porto and the University of Coimbra have implemented structured academic support systems, helping first-year students adjust.
* **Psychological counseling services**: These address student stress, mental health concerns, and social integration—key factors linked to dropout according to multiple studies.
* **Early alert systems**: Some universities use predictive analytics to identify students at risk of dropping out and intervene early.

📌 *Reference*:  
Cardoso, A. R., & Ferreira, P. (2023). *Addressing the Completion Challenge in Portuguese Higher Education*. Harvard Kennedy School Working Paper.  
Available at: <https://www.hks.harvard.edu>

**⚖️ Key Gaps & Areas for Policy Improvement**

|  |  |  |
| --- | --- | --- |
| **Area** | **Observation** | **Recommendation** |
| National Policy | Focused heavily on early education (PNPSE) | Develop a **University-Specific National Dropout Strategy** |
| Funding & Aid | Scholarships exist but target only the poorest | Expand financial support to middle-income students at risk |
| Institutional Coordination | Efforts vary by university | Promote **standardized best practices** across institutions |

**7. Development of a Comprehensive Retention Framework (3-Year Plan)**

To effectively reduce university dropout rates in Portugal, we propose a **3-year, evidence-based retention framework** that blends **preventive measures, targeted interventions, and policy-level enhancements**. This plan is informed by both data analysis from our project and international best practices.

**Year 1: Early Prevention & Detection (Proactive Phase)**

**Objective**: Prevent dropout risks before they fully emerge.

**Key Actions**:

* **Predictive Analytics Models**: Deploy ML tools (like Random Forest, used in this study) to identify at-risk students early based on academic, financial, and demographic factors.
* **Orientation & Mentorship Programs**: Connect new students with senior mentors to ease the transition to university life.
* **Scholarship & Financial Aid Reform**: Expand eligibility criteria to include low-to-middle income students.

📌 *Reference*:

* Almeida & Azevedo (2022). *The Role of Financial Support in Reducing Higher Education Dropouts*. *Higher Education Quarterly*.

**Year 2: Targeted Interventions (Responsive Phase)**

**Objective**: Support students already showing signs of disengagement or academic struggle.

**Key Actions**:

* **Academic Support Centers**: Scale tutoring, writing centers, and subject-specific support.
* **Mental Health & Counseling Services**: Offer confidential, no-cost psychological support for stress, anxiety, and social integration issues.
* **Flexible Learning Structures**: Expand part-time, online, or evening course options for working students.

📌 *Reference*:

* Cardoso & Ferreira (2023). *Gender differences in higher education dropout: Evidence from Portugal*. *Education Economics*.
* UTAD University Study (2022). *Forecasting student dropout using machine learning models*. *MDPI*.

**Year 3: Institutionalization & Policy Expansion (Sustainability Phase)**

**Objective**: Embed successful strategies into long-term institutional and national policy.

**Key Actions**:

* **Retention Policy Standardization**: Develop a nationwide university dropout reduction protocol shared across all institutions.
* **Annual Monitoring Dashboard**: Use tools like Tableau to track dropout metrics, segment trends (by gender, nationality, region), and adjust programs accordingly.
* **Stakeholder Engagement**: Form university–government–community taskforces to ensure collaborative execution and feedback loops.

📌 *Reference*:

* European Commission (2024). *Education and Training Monitor – Portugal*.
* OECD (2023). *Education at a Glance*. *Education GPS*.

**Final Outcome**

This framework not only tackles **academic, economic, and psychosocial contributors to dropout**, but also ensures **sustainability and adaptability** through data-driven evaluation and continuous improvement.