# Attune

Real-time Insights for Smarter Classrooms

04/27/2025

Joshua Lute

John Paul Vela

Cooper Randeen

Jonathan Sum

UCLA InT BioHackathon, 2025

# Introduction

With 11% of students diagnosed with ADHD and autism spectrum disorder continuing to rise within the K-12 population, many school districts, teachers, and parents feel overwhelmed and uncertain as their students fall behind from their neurotypical peers. The conventional classroom can present challenges to these students and often inadequately meet their unique learning needs. Neurodivergent students often face difficulties expressing confusion during a lesson and are frequently distracted. Likewise, teachers may often overlook these students as they administer to the classes' broader needs or fail to accurately gauge the student's true cognitive state—whether it be confusion, inattention, frustration or excitement. These shortcomings can hinder the adaptation of educators, parents, and therapists to address each student's unique learning needs, potentially leading to frustration and missed learning opportunities.

# Problem Statement

Neurodivergent students often have trouble expressing their learning needs and have trouble engaging and focusing in class. Teachers cannot adequately meet each student's difficulties while managing other students.

# Solution

Using an inexpensive preexisting brain-computer interface (Muse S), Attune tracks EEG signals in real time and uses machine learning to detect confusion or disengagement in students, while also providing helpful tools for teachers to improve student outcomes.

## Development

Team members were able to train a machine learning algorithm to detect states of confusion and inattention based on EEG signals gathered from the Muse. The algorithm then provides real-time feedback to the teacher via a desktop app. The machine learning algorithm was trained with 3 labeled data sets: confused, engaged, and control. The confused data set was collected by having

the test subject watch a high-level lecture on quantum physics. The engaged data set was collected by having the test subject watch a simple cooking instructional. The control data set was collected by having the test subject let their mind wander. Each data set was collected for 5 minutes then used to train the machine learning algorithm. The machine learning algorithm was verified by having it analyze unlabeled data sets and see if it could distinguish between them.

After researching and testing various methods of classifying our EEG data, we decided to take a machine learning approach, in particular using convolutional neural networks (CNNs). Most researchers have extracted the features in the form of gamma, alpha, beta, etc, frequency bands and filtering out certain ranges. However, to conserve the granularity of each individual electrode, we opted to train our models on the raw EEG data and let the model learn what features are important rather than filtering it ourselves. CNNs are typically used for computer vision tasks, but their feature extraction mechanisms make them perfect for this task.

The sample rate on the Muse is 256 Hz over 4 electrodes. We then recorded each sample in 1-second windows with 80% overlap between them to make efficient use of our data. This resulted in each sample being a 256x4 matrix, which can then be treated as an image classification problem. The specific architecture used in our models is 3 convolutional layers paired with 3 max-pooling layers, followed by a final convolutional, flattening, fully connected, and output layer. The output layer has 3 neurons for our “control”, “confusion”, and “understanding” classes, respectively, outputting the probability scores for each class using the softmax activation function. Because of the temporal dependencies of EEG data, each convolutional layer only strides on the time dimension (rows) while finding patterns across all 4 electrodes. This allows the network to still learn temporal patterns despite not using a more sequential-based neural network, such as a recurrent neural network. Above all, one of the main benefits of using a CNN is that it is very robust to artifacts and noise in the data compared to other sequence-dependent models. Due to the nature of EEG, it is very noisy and prone to artifacts from blinking and other muscle activation. However, as long as the noise and artifacts are included in the training data, the network will learn to ignore them and extract the important features. Finally, using 35 minutes worth of data, 85% for training and 15% for validation, we achieved a validation accuracy of 83%.

Once completing the data gathering and machine learning training, we integrated the algorithm into a desktop app, (Attune). Attune was developed using HTML, CSS, React, and Typescript.

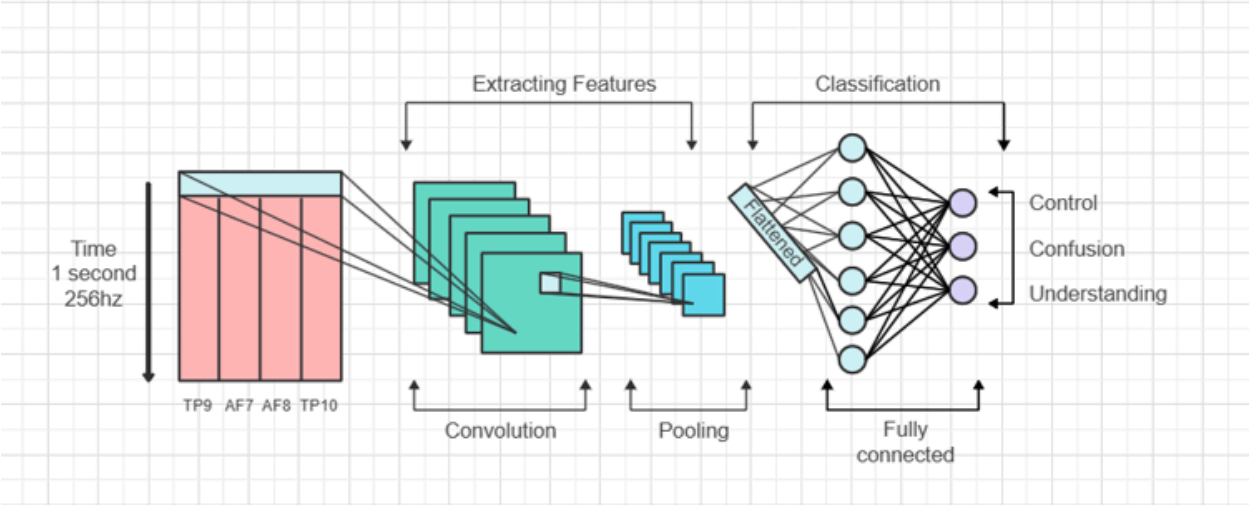


*Figure 1: Machine Learning Architecture*

## Product Description

Attune is a desktop app for teachers that shows the wearer's current confusion and engagement levels in real time by connecting via Bluetooth with the Muse brain-computer interface. It also records the lesson being given, uses AI to summarize the lesson, and marks where the students were confused or disengaged. It generates a "here's what you missed' report, showing regions where students may have missed content, and accurately summarizes the content within.

The desktop app allows teachers to observe student's engagement/confusion while teaching, as well as being able to look back at where each student struggled to pay attention or was confused. The teacher can observe the general trends where students struggle the most and then adjust accordingly.

Attune also includes a teacher-parent-therapist portal which allows parents and therapists to observe the progress their child is making. The feedback given to the parent and therapist will allow them to adjust and work on behaviors outside the classroom as well as collaborate with the teacher to better optimize student learning.

Because of the uniqueness of each student's brain, teachers will need to calibrate each Muse for each individual student through a series of short tests. This custom training for each student

allows the machine learning algorithm to be tailored to each student's specific brain fingerprint, allowing for more accurate results.

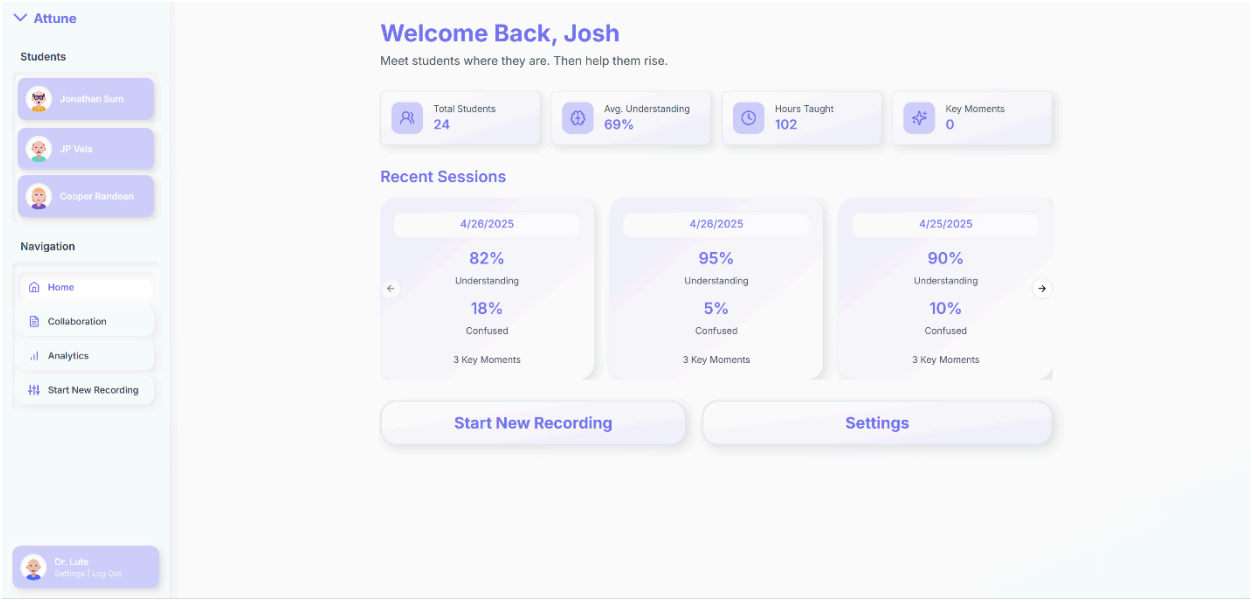


*Figure 2: A display of the homepage of the app*

# Market Research

## Compounding Annual Growth Rate (CAGR)

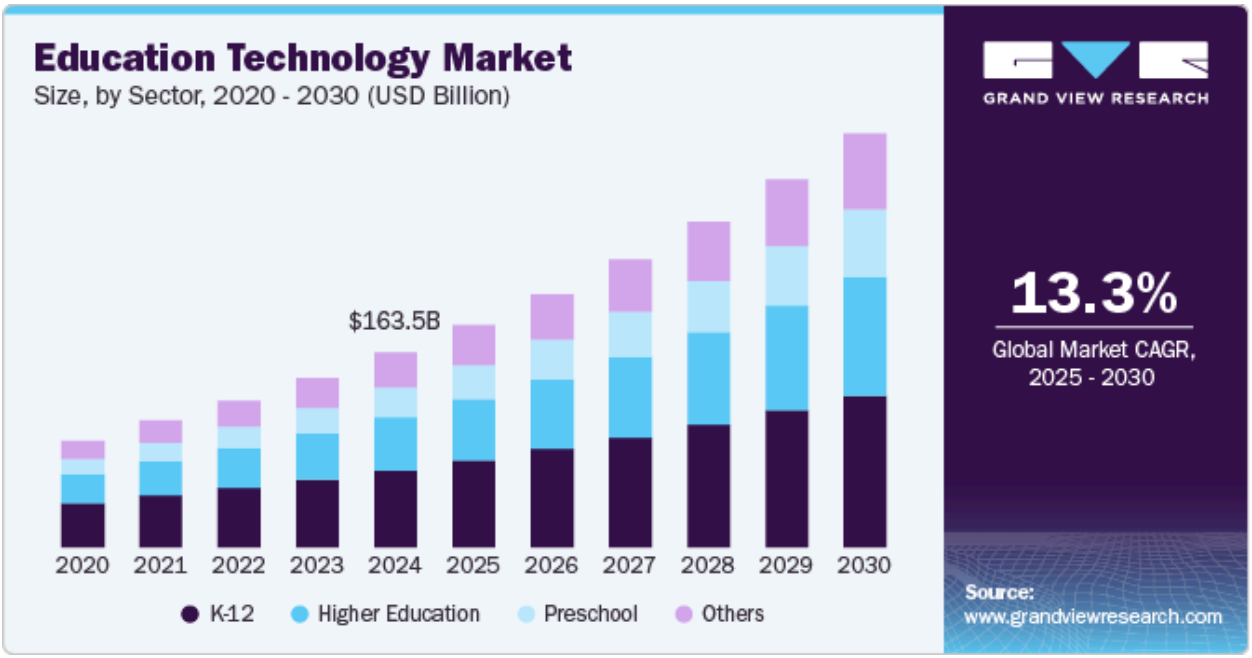

*Figure 3: Global EdTech CAGR*

The global edtech's market current evaluation is prices at about $163.5 billion. This, in addition to the growing awareness and prevalence of ADHD and ASD,  positions Attune in an optimal time for growth in the expanding market.

## Total Acquirable Market (TAM)

The total acquirable market for Attune includes global Edtech spending, currently around 163.5 billion, according to Grand View Research.

## Serviceable Available Market (SAM)

Given the fact that neurodivergent children make up around 14% of the K-12 population, it is safe to assume that the SAM will be 14% of the TAM, or about $22.9 billion.

## Serviceable Attainable Market (SOM)

The total serviceable market will amount to about 1-3% of the total US and Canada neurodivergent student market share (8 million individuals). This will amount to approximately $28.8 million, or 80,000 licenses distributed at $360/year. Once firmly established, Attune will seek to expand growth in this field through expansion in the domestic and international markets, as well as partnerships with EdTech distributors

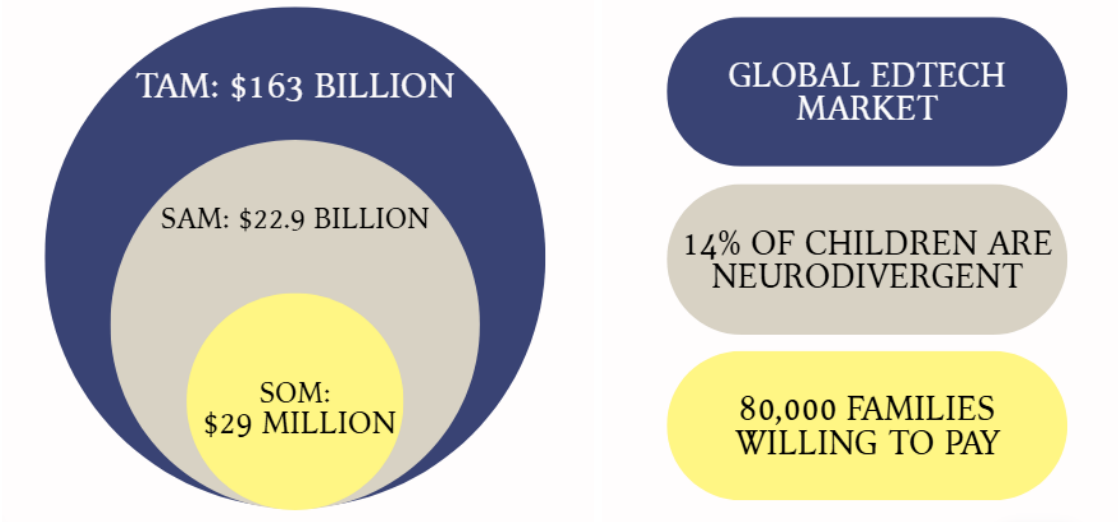


*Figure 4: TAM-SAM-SOM Market Analysis*

## SWOT Analysis

| Strengths | Weaknesses |
|---|---|
| - One of the first of its kind to market<br>- Addresses known pain point for both teachers and students<br>- Enables real-time cognitive state feedback, improving teaching methods and student outcomes<br>- Uses pre-existing hardware and easily scalable subscription model | - Requires purchase of Muse device, ($250) to use, may be cost prohibitive for many families<br>- Requires custom calibration for each student, may be difficult and tedious for educators of larger institutions<br>- Neurodivergent children may not tolerate the continual usage of the wearable, must ensure good student experience<br>- Movements and fits can affect signal quality and deliver inaccurate or invalid results |
| **Opportunities** | **Threats** |
| - EdTech and neurodiversity support technologies are growing, can integrate with existing school software (Canvas, Google Classroom)<br>- Potential for collaboration with universities, schools, and therapists to achieve clinical validation<br>- Ongoing development, commercialization, and normalization of BCIs in everyday life enables further improvements and applications of Attune | - Economic downturn could lessen demand<br>- Potential decrease of government funding will impact public school sales<br>- PR issues of monitoring children's cognitive state may spark privacy and ethical concerns |

# Revenue Model and Pricing

Attune will be a subscription-based SaaS model. Attune plans on partnering early on Muse to co-market and sell the software with the Muse hardware. Pricing options will vary based on the software's tier level and whether the customer is looking for an individual or institutional license.

The software will consist of two tiers: Basic and Pro. Basic will include real time tracking of confusion/engagement, summary and recording of lessons from the past 14 days, and the parent/therapist portal. The Pro license will include all the features of the basic as well as unlimited recording of lessons, custom AI insights based on each student's learning, advanced

cognitive state analytics (confusion/inattentiveness likelihood over time) and downloadable progress reports.

| Pricing Options | Basic | Pro |
|---|---|---|
| Individual License: parents, individual therapists | $250 for Muse + $360/yr | $250 for Muse + $600/yr |
| Classroom bundle (5-10 students): Clinics, small schools | $230/student upfront + $300/student/yr | $230/student upfront + $500/student/yr |
| *Institutional License (10+ students): Larger schools, districts. | Contact for quote (estm. $8,000-$15,000 including Muses) | Contact for quote (estm. $12,000-$20,000 including Muses) |

Customers will also have the option to purchase just the software subscription for all the above pricing options.

*Institutional license purchases will include options for on-boarding sessions for teachers, institutional-wide administrative analytics, integration with current learning management software, and dedicated support.

# Go-to-Market Strategy

Attune's go-to-market strategy consists of three phases:

Phase 1: Begin beta-testing software by partnering with 5-10 small special education clinics and individual therapist. Through CBU's (California Baptist University) School of Education, Attune will reach out to local clinics and special education schools and ensure the software's effectiveness. This collaboration will include the free use of the software in exchange for valuable feedback on both the user experience and effectiveness in improving learning outcomes. Attune will also begin testing in classrooms in Singapore due to the country's wealth, common language, and openness to technology and innovation in learning environments. Once adequate feedback is gathered, Attune will make the necessary adjustments and improvements to the app and algorithms.

Phase 2: Partner with Muse to bundle pricing and possibly co-market. Attune will also collaborate with established EdTech distributors to market towards larger private schools and public-school districts, as well as integrate with preexisting education software (Google Classroom, Canvas, Schoology). Attune representatives will attend EdTech and special education conferences throughout North America to further reach 50-150 clinics, parents, and schools.

Phase 3: Attune will seek to expand in the North American market as well as overseas, particularly in wealthy East Asian countries. Marketing teams will continue to attend in-person conferences and events while also tailoring online advertisements to increase Attune's global reach. The goal is to reach over 1,000 customers, both schools and individuals.

## Competitor Analysis

Attune's main direct competitor is FocusCalm by BrainCo. FocusCalm is another BCI and software that focuses more on mental health wellness and mindfulness and markets to the general student population. It integrates mindfulness checks, games, and analytics for students through the FocusCalm headband and app. BrainCo formerly marketed its device as a similar attention tracking BCI but pivoted due to widespread public criticisms of perceived surveillance. This attention-tracking device used a general AI algorithm (not one trained and calibrated on each individual student), while also again being geared for the neurotypical student. Attune is set apart from this by tailoring the software specifically for each neurodivergent student, while also focusing on confusion, not just attentiveness. This narrower market focus not only addresses a more specific problem, but also positions Attune to avoid the ethical backlash that impacted BrainCo's earlier efforts. Attune will empower both families and teachers to bridge the educational gap between neurotypical and neurodivergent students.

Indirect competitors include behavior tracking apps, AI tutors, and task managers, such as Khanmigo, ClassDojo, and Todoist. These apps primarily rely on subjective tracking and require an educator to personally manage each student. Attune integrates all of these apps into one place with its parent/therapist portal, AI teaching insights, and manual behavior marking tool, while also providing objective, real-time feedback using EEG signals.

| Feature / Platform | Attune | FocusCalm (BrainCo) | ClassDojo | Khanmigo (Khan Academy AI) | Mightier | Todoist |
|---|---|---|---|---|---|---|
| Neurodivergent Focus | ✅ | ❌ | ❌ | ❌ | ✅ | ❌ |
| BCI/EEG Integration | ✅ | ✅ | ❌ | ❌ | ❌ | ❌ |
| Personalized AI Calibration | ✅ | ❌ | ❌ | ❌ | ❌ | ❌ |
| Confusion Tracking (not just attention) | ✅ | ❌ | ❌ | ❌ | ❌ | ❌ |
| Behavior Tracking | ✅ | ❌ | ✅ | ❌ | ✅ | ❌ |
| Academic Support Tools | ✅ | ❌ | ❌ | ✅ | ❌ | ✅ |
| Parent / Therapist Portal | ✅ | ❌ | ❌ | ❌ | ✅ | ❌ |
| Real-time, Objective Feedback | ✅ | ❌ | ❌ | ❌ | ❌ | ❌ |

*Figure 5: Competitor Comparison*

# Conclusion

Though public awareness and accessibility efforts surrounding neurodivergent conditions such as ADHD and autism spectrum disorder have gone up, many K-12 students with these conditions still fall behind in their studies compared to their neurotypical peers. Attune seeks to remedy this problem by empowering teachers, parents, and therapists to better understand their students' needs. Through its confusion/attention tracking, AI-driven teaching insights, and integrated parent/teacher portal, Attune paves the way for a brighter, more equitable future for all neurodivergent students. By investing in Attune, stakeholders can help build a future where every student has the tools they need to thrive.

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# Links for Code and Video

https://drive.google.com/file/d/1syiPWHtlyv84MU_bYzzikJJ1JfuI-DYo/view?pli=1

https://github.com/JP-Vela/BioHack2025